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NOTICE.

Notice is hereby given that the resolution, embodied in the Report of Council to the Annual General Meeting, 1884, which forbids the publication of communications other than those read before the Society or its Sections, is now rescinded. Communications bearing upon Technical Chemistry can now be sent to the General Secretary, and, if they be approved by the Publication Committee, will be inserted in the Journal.

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(unless otherwise indicated).

July.—The Annual General Meeting.
Notices of papers and communications for the meetings to be
sent to the Local Secretary.

Meeting held June 1, 1885.

DR. CHAS. GRAHAM IN THE CHAIR.

THE INFLUENCE OF PHOSPHATES UPON
FERMENTING WORTS.

BY ALFRED GORDON SALAMON, A.R.S.M., F.C.S.; AND
W. DE VERE MATHEW, F.I.C.

THE various considerations which might suggest themselves as affording scope for argument in connection with the research, which we have the honour of submitting to you to-night, are necessarily of a most complex and intricate character; because of the veil of mystery which still envelopes so many of the phenomena, collectively constituting the process of fermentation. Hence it is that we feel the necessity of at once disposing of the possible charge of having aimed at too much, and of stating emphatically that our object has been to solve a problem savouring rather of industrial than of purely philosophic interest; to offer a few contributions which may possibly be capable of direct assimilation to the work of the practical brewer, rather than discuss the abstruse biological and physiological aspects of a subject, of which the sum total of our information must still be said to be represented more by its high-flown nomenclature, than by the extent of knowledge which such nomenclature might be assumed to imply.

If we examine the analysis of the ash of the yeast plant, we shall find that phosphorus enters very largely into its composition. The exact condition in which it exists is probably unknown; but inasmuch as potash is present in notable quantities, and cannot be satisfactorily accounted for in combination, unless by reference to the contained phosphorus, it is assumed, and probably correctly, that the phosphorus of yeast is chiefly combined with mineral bases; and, indeed, that it exists almost entirely as phosphate of potash.

Inasmuch as there is no record of a sample of yeast ever having been isolated of which the ash could not

be proved to contain phosphorus; and since experience has proved that no satisfactory growth of the plant takes place in a medium devoid of a certain quantity of this element, it is further assumed—and again we must agree with the deduction—that it constitutes a nutritive element, which is absolutely necessary to a favourable growth and development of the yeast.

If the assumption had been carried no further than this, we should have had no occasion to trouble you with our observations to-night; for we should scarcely have ventured to attack the very difficult, but exceedingly interesting, problem of determining what rôle it is that phosphorus actually plays in the nutrition of the plant. But matters have not been allowed to rest here; and it has been urged—apparently with the idea that one cannot have too much of a good thing—that it is advisable to introduce additional phosphate into the medium in which fermentation takes place. We find, for instance, that bone ash is often added, in certain of the wine districts of France, with a view to accelerate the action of the ferment; and, further, that several of the authorities, to whom the brewers look for scientific instruction, advocate the addition of certain phosphates to fermenting worts, in order to increase the efficiency of the action of the yeast. Of late this practice has become so pronounced that there are now several so-called yeast-foods in the market, the active principle in all of them consisting of some form of phosphate.

Now, so far as our reading carries us, we can find no record of any systematic series of experiments having been undertaken, with a view to determine whether any benefit really results from such an addition; and in its absence we are led to the conclusion that the practice is one which is absolutely empirical. In saying benefit we must be understood to limit the expression to the ultimate product of the manufacturer; for it would be obviously difficult, if not impossible, to separate the newly-formed cells from the old in such a manner as to determine whether the young cells assimilated more phosphorus than the parent cells. Such a consideration would constitute a type of what we have termed the biological, or physiological, aspects of the question. But it does seem possible to investigate the matter so as to arrive at results which shall have some distinct practical value, and which shall decide whether the use of such "foods" is objectionable or commendable.

In view of the great importance which the subject of yeast nutrition and development possesses for the brewer, we have been induced to undertake the experiments which we now submit, in order to assist him in forming some reliable opinion upon the matter. The vast scope of the subject has, however, compelled us to limit our experiments to brewing operations, and we would state that although they may have some bearing, they have no direct reference to the work of the distiller, or the producer of wine.

Granting that the presence of a certain amount of phosphorus, in some combined form, is necessary to the due activity of yeast, it becomes important to inquire to what extent this element is present when brewing operations are conducted under normal conditions; how much is assimilated during the process of fermentation; and, further, whether any remains unused in the finished beer.

If it can be shown that finished beer contains a notable amount of phosphorus, originally derived from the malt, and subsequently passing into the wort; that some of the phosphorus of this wort has been absorbed or assimilated during fermentation, and that a considerable proportion has been left untouched; then—inasmuch as the finished beer has no opportunity of obtaining any phosphorus which it did not contain in the wort—unless it can be proved

that the phosphorus, which is left, has undergone some modification of combination, which has rendered it inert for purposes of yeast assimilation; or that it originally existed in an unavailable condition, it would certainly appear, *prima facie*, that there can be no object in adding a further supply.

The following tables of analyses which we have performed, are instructive upon this point:—

ANALYSIS OF SAMPLES OF 1884 MALT.

No.	LOCALITY.	ON DRY SUBSTANCE.			
		Ash.	Total N.	Soluble N.	P ₂ O ₅ .
		Per cent.	Per cent.	Per cent.	Per cent.
1.	Austria	2.51	1.160	.956	1.101
1.	Moravia	2.17	1.371	.932	.935
3.	Hertfordshire	2.29	1.385	1.103	.917
4.	Suffolk	2.19	1.316	.789	.919
5.	Nottinghamshire..	2.26	1.277	1.189	.889
6.	Co. Kildare	2.31	1.623	.821	1.082
7.	Sweden	2.17	1.665	.910	.995
7.	Suffolk	2.19	1.593	1.193	.880
9.	Suffolk	2.09	1.610	.877	.825
10.	Suffolk	2.21	1.700	.759	.913
11.	Pflosshire	2.81	1.121	.815	1.101
12.	Suffolk	2.09	1.686	.911	.858
13.	Wexford	2.31	1.551	.716	.718
14.	Essex	2.33	1.351	.905	.913
15.	Kings Co.	3.30	1.152	.662	1.023
[16.]	Smyrna	3.11	1.598	.811	.732

TABLE SHOWING AMOUNT OF P₂O₅ IN VARIOUS WORTS.(P₂O₅ in grammes per 100 cc.).

1.	.179 grammes (pure malt wort).
2.	.197 " containing brewing sugar.
3.	.111 " " "
4.	.086 " " "
5.	.088 " " "
6.	.130 " " "
7.	.075 " " "
8.	.118 " " "

TABLE SHOWING AMOUNT OF P₂O₅ REMOVED FROM WORT DURING FERMENTATION.(P₂O₅ in grammes per 100cc.).

	Wort.	Beer.	P ₂ O ₅ removed.
1.	.193	.143	.050
2.	.122	.094	.028
3.	.067	.051	.016
4.	.180	.159	.021
5.	.166	.138	.028
6.	.127	.100	.027
7.	.107	.082	.025
8.	.074	.057	.017

The phosphoric acid estimations contained in the above tables, as indeed all similar analyses to which we shall have occasion to refer in the course of this paper, were made gravimetrically upon the ash yielded by a given quantity of the liquid, or the malt. The phosphate was precipitated with ammoniac molybdate solution, and allowed to stand in a warm place all night, and then filtered off. The precipitate was next dissolved on the filter with ammonia and reprecipitated with magnesia mixture. After allowing to stand in the cold for at least twelve hours, the resulting ammoniac magnesian phosphate was filtered, thoroughly washed, strongly ignited, and the resulting magnesian pyrophosphate weighed.

An inspection of the table showing the amount of P₂O₅ removed during fermentation, proves that the quantity required for yeast nutrition, or whatever function it may perform, is exceedingly small. We have never met with a case in which, during what we may term the commercial limits of attenuation, the quantity thus removed has exceeded .05 gramme per 100cc. of wort fermented.

Again, the table clearly shows that in every case, at the conclusion of the fermentation there exists a quantity of unabsorbed, or unremoved, phosphorus. As we have stated, this *may* exist in some form of combination different to that which *has* been removed; and consequently it may be present in an absolutely inert condition; but we are ourselves unaware of any reliable arguments, which could be adduced to support such a contention.

The practice, now almost universal in English brewhouses, of employing a certain quantity of some ready-made brewing sugar in the process of manufacture, will undoubtedly have the effect of reducing the amount of phosphorus present in the wort. Advantage has been taken of this fact to urge the desirability of adding yeast-foods to supply this deficiency. In order to test the value of this assertion, we have estimated the amount of phosphorus (as P₂O₅) in worts containing brewing sugar, and obtained from various parts of the country; and it will be seen that in every analysis we have made, we have found considerably more phosphoric anhydride present in the wort than we have found to be removed during the normal period of fermentation.

Hence it would certainly appear that English beer worts do contain much more phosphorus than is required for fermentative purposes.

The analyses of the malts have disclosed certain facts, so distinctly at variance with the doctrines promulgated by some of our leading authorities; that at the risk of a somewhat serious digression from the true scope of our paper, we feel compelled to direct attention to them.

In a paper upon lager beer read before this Society by Dr. Graham, the following statement occurs:—Speaking of the analyses of lager beer, he says: "In these analyses the nitrogen has been determined by the soda lime process which is employed by most German analysts, by whom the factor 6.25 is used to convert the nitrogen into albumenoids. This is misleading, and gives results far too high, since all nitrogenous compounds are thus calculated as albumenoids. For many years past I have used boiling alkaline permanganate as a more correct method of arriving at the albumenoids, and in the analyses of the English ales and German beers made by me, the albumenoids so found were given. Though the process is far from being scientifically accurate, yet the method, from a technical point of view, has been of great service to me in forming an opinion as to the relative merits of *malt* from an English brewing point of view; and of equal service in deciding as to the keeping qualities of store ales. Thus with English ales I have, for some years past, adopted the factor .01 of albumenoids, as given by the moist combustion process, as the standard for sound English ales per lb. per barrel original gravity;" and again further on he states that "we find English brewers competing with each other for the finest barleys, *that is, for those with least yield of soluble albumenoids.*" (The italicised portions of these quotations are underlined by us.)

Now those who have had any experience with the moist combustion process, as applied to the determination of nitrogen in malts and worts, will cordially agree with Professor Graham, when he speaks of its scientific inaccuracy; and, unless it be upon the

score of convenience, we cannot see that it is to be preferred to the old-fashioned soda-lime process. Undoubtedly, it may afford comparative results, and would seem to have induced Dr. Graham to form the opinion—which is the only one to be inferred from the above quoted passages—that for the purposes of the English brewer the best malts are those which yield the least amount of soluble albumenoids; and inasmuch as he has fixed a standard of soluble albumenoids for ales, above which he would not pass them for store purposes, we feel further justified in concluding that he would condemn, as unfit for use by the English brewer, a malt giving a high yield of soluble albumenoids.

Now this decision, coming from so great an authority, is of such importance to English brewers and maltsters, that we would ask your indulgence while we examine into its accuracy.

The nitrogen determinations, as represented upon our table of malts, were made in the following manner:—

For the total nitrogen, about 2grm. of the finely-ground malt were washed into a combustion tube with copper oxide, and the usual roll of copper was inserted in the tube. The unsealed end of the tube was then drawn out, and connected with a Sprengel pump; the furnace being lighted at the end farthest from the malt, the pump was started and a vacuum obtained; and the combustion was then effected in vacuo. Over the mouth of the delivery tube of the pump was placed a tube containing mercury, and also some strong caustic potash, to absorb the carbonic anhydride, evolved as a product of the combustion of the malt. The resulting nitrogen gas, collected over mercury and caustic potash, was next transferred to a gas apparatus, and, after all necessary corrections had been made, the volume of nitrogen thus measured was converted into its corresponding weight in grammes.

For the soluble nitrogen, a mashing of the malt upon the small scale was made; but inasmuch as we preferred to work with small quantities of material, we did not dilute the extract until it obtained the quantity of soluble nitrogen, that would be represented by an English wort. Such a dilution was quite unnecessary for our purposes. In each case, the method of procedure was absolutely the same, *so that the results are rigidly comparable*. We proceeded as follows:—A grist corresponding to that in use in breweries was made of each sample of malt; 25grm. of malt were weighed into a beaker, into which 125cc. of distilled water were introduced, at such a temperature that the initial heat was about 50° C. This was maintained for about twenty minutes. The temperature was then raised to about 60° C., and thus maintained until the iodine reaction showed that a complete conversion had been effected. The temperature was then raised to about 70° C., and then the water in the bath was made to boil for about five minutes. The extract was next filtered off hot, and washed out in each case to the same extent. It was cooled, and then 1cc., after well stirring, was evaporated gently, and the residue submitted to combustion in vacuo, as before.

The resulting soluble nitrogens, thus obtained, were not multiplied by us by the factor 6.25; because, with all deference, we regard the use of such a factor as simply effecting an increase in the possible error of experiment; and, at the same time, as expressing the ignorance, which we share in common with other chemists, as to the true mode of combination of nitrogen, and more especially of soluble nitrogen, in malts and worts.

Dr. Graham maintains that the total soluble nitrogen estimations, as indicated by the soda-lime process, are far too high, since all nitrogenous compounds are thus calculated as albumenoids; but we take it that Dr. Graham would scarcely contend that the nitrogen results, as yielded by the moist combustion process, give a reliable indication of the *manner* in which the nitrogen is combined—that they show any distinction between the amides and proteins and peptones. Dr. Graham's results being lower than those obtained by the soda-lime process, it would be interesting to know in what manner he accounts for the remaining nitrogen, which is undoubtedly present. In what form does it exist? It is certainly in a soluble condition; and what reasons are there for regarding it other than as soluble albumenoid matter? If there are any reasons, are they sufficient with which to build up a standard which shall condemn or pass malts for brewing purposes? In the absence of further information we are inclined to think they are quite insufficient; and we can further state that results which we have seen obtained by this moist combustion process are simply mystifying.

We have felt it necessary to take these preliminary objections, because the results which we have obtained show that on no account should a malt be condemned for English brewing purposes because it contains a high amount of soluble nitrogenous matter.

In order to give our results some practical value, we decided to obtain the opinion of experts upon the physical appearances of the malts upon which we experimented, and to see how their verdict would correspond with our analyses. Among others we submitted them to Mr. Frank Wilson, the head brewer to Messrs. Combe & Co., who kindly undertook to classify them for us. The sixteen malts (supplied from the bins of different breweries) were laid out upon a table, and the laboratory number was placed upon each sample. The malts were not placed in what we considered their order of merit, but indiscriminately, and Mr. Wilson had no information, other than his experience to guide him. The numbers upon the Table of Malt Analyses represent the exact order in which he placed them. The sample of Smyrna malt being so different from the others could be at once detected, and was, therefore, placed out of the competition. Now, looking at the amounts of soluble nitrogen in the fifteen remaining malts, and further, having reference to the order in which they were placed, it will at once be seen that the best malts are among those containing the highest percentages of soluble nitrogen, and that the worst of all (No. 15) contains the least. This last was declared by Mr. Wilson to be *very deficient in germinating power*.

We do not go so far as to reverse Professor Graham's statement, and declare that the more soluble nitrogen a malt yields the better it is for brewing purposes; but we do think that such an assertion would be nearer the truth than the converse.

A practical result, arising from Mr. Wilson's verdict upon the malts, is that a malt, which appears to have been well nourished upon cultivated land is, other things being equal, richer in soluble nitrogen than a poorly grown malt, and this is probably the reason why the malts are placed as they are in the table.

The amount of nitrogen in malts and worts is undoubtedly of the very greatest moment; but we submit that very little is to be gleaned from its estimation until we are in a position to determine the mode of combination in which it is actually present.

We should add that other gentlemen who were good enough to examine the malts, placed them almost exactly in the same order as did Mr. Wilson.

[Mr. Salamon here asked the Chairman's permission to inform the meeting that he had that day seen Mr. Wilson, and had read the paper to him. Mr. Wilson had authorised him (Mr. Salamon) to express to the meeting his regret at being prevented by indisposition from attending; and further, to state that he entirely agreed with the interpretations which had been placed upon his classification of the malts as given in the table.]

It has been repeatedly stated that the standard of a good malt, when considered with reference to its fitness for use in the decoction process, does not necessarily constitute a standard for judging of the suitability of a malt for use by the method of infusion. This arises from the fact that beer produced by the decoction process contains more nitrogenous matter in solution than does the beer prepared by the process of infusion. If this statement be rigidly correct, it detracts to a certain extent, in the eyes of the English brewer, from the value of the researches, which have been conducted by foreign observers upon this question; but it can scarcely interfere with the importance attaching to the results which they have published respecting yeast nutrition.

So far as the nitrogen in malts and worts is concerned, we find that they substantially agree with our own observations. Let us briefly glance at some of them.

K. Reischauer (*Bied. Centr.* 1882, 42) finds that malted barleys differ very materially in their composition. He summarises his results as follows:—

	Nitrogen.	Ash.	P ₂ O ₅ .
Maximum ...	2.856	3.340	1.145
Minimum ...	1.282	2.120	.614
Mean ...	1.729	2.799	.902

Dr. C. Lintner, an authority of great repute, goes so far as to state (*Dingl. Polyt. J.* 251, 225-228) that the amount of nitrogen in barley or malt bears no relation to its diastatic action, and he also expresses it as his opinion (*Dingl. Polyt. J.* 247, 350) that barley should contain at least 1.67 per cent. of nitrogen in order to produce a good beverage.

Thausing, whose book upon brewing is so highly esteemed in this country, makes a statement (*Dingl. Polyt. J.* 247, 350) which will surprise not a few of you here to-night, to the effect that a wort will not form a good nutrient for yeast unless it contains a comparatively large amount of soluble nitrogenous matter. It is only within recent years, he says, that this fact has received the attention which it deserves; and it is now recognised that barley containing little proteid matter gives malt, the starch of which is with difficulty convertible into sugar.

It is interesting to compare this statement with Mr. Wilson's opinion upon No. 15 malt as analysed by us.

Heinzmann (*Bied. Centr.* 1880, 475-478) finds that the yeast-producing power of grain is not proportionate to the quantity of nitrogen it contains, but to the amount of soluble protein. This he states to be a very variable quantity.

Some chemists consider the presence of soluble nitrogen of such importance in promoting germination, that they go so far as to recommend its addition to the steep-water used in the production of malt. Thus, Mills and Pettigrew (*Chem. Soc. J.* 1882) advise the use of small quantities of calcic nitrate for this purpose, and they are confirmed in their view by Michel and Jaekel-Handwerk (*Dingl. Polyt. J.* 247, 82-85, 168-173, 214-218), who state that the reputation of the Burton steep-water is attributable to the fact that it contains nitrates, which promote germination.

[We have not had an opportunity of repeating these last interesting experiments, and therefore we merely quote them.]

A question which has not yet received its due share of attention, but which is undoubtedly of the greatest importance, arises out of the influence of kiln-heat upon the nitrogenous constituents of malt. It is found that the amount of nitrogen diminishes with the increase of heating, but (*Bied. Centr.* 1881, 357) that the change in the amount of nitrogen produced by malting at a high temperature, does not correspond with a change in the diastatic action of the malt. Hence it is necessary to examine malt, with respect to its firing, before forming any opinion as to the amount of nitrogen present in it.

We have again to request that the importance of the subject into which we have digressed may be considered as a sufficient excuse for our having committed the offence.

In making the estimations of soluble nitrogen in the malts, we were under the impression that we might possibly discover the existence of some relation between the quantity of nitrogen and of phosphorus. In this view we were mistaken; no such relation exists; and we have since found that we are confirmed in this opinion by L. Marx (*Bied. Centr.* 1884, 853-855), who made no less than 400 analyses of different malts with an exactly similar object. All that we can say is, that the amount of phosphorus in malts varies within very wide limits; and that when the barley is grown on a highly cultivated land, the amounts of phosphorus and of nitrogen will both be high; and that when the land is poor, as in the case with Smyrna malt, the amount of phosphorus will be low. When the phosphorus is low, the yield of barley will probably not weigh so much per acre; but for brewing purposes, as regards the quality of beer obtainable, the malt produced from it may be equally good. Thus, the first two malts upon the list are both classed as No. 1 for brewing purposes, because they are equally good as judged by external appearances; but Mr. Wilson is of opinion that the yield per acre of Austrian malt would have been much greater than of Moravian; and we find that the former is much higher in phosphorus and soluble nitrogen than the latter. Again, Smyrna malt, which is exceedingly useful in some cases, would not yield a large crop by weight; and we find that it is low in its percentage of phosphorus.

But although good malts in many cases yield a high percentage of phosphorus, it by no means follows that an excess of it exerts a favourable action either upon the character of the wort or the subsequent fermentation. Indeed, we have every reason to believe that the contrary is the case.

It is known that certain of the soluble nitrogenous bodies, germane to worts, are exceedingly rich in phosphates. This is especially the case with the unreal peptones, which are said to contain the phosphorus in the form of a compound ether. One of these unreal peptones—viz., gluten-casein—frequently exists in considerable quantities in worts. It is decomposed on boiling, so that when the wort "breaks" the phosphorus passes into solution in the form of acid phosphates; and Thausing states that they are in a great measure responsible for the acidity of worts, and ascribes to such decomposition of certain nitrogenous combinations the fact, which he has noted, that the longer a wort is boiled the more acid it becomes.

If this be so, it can scarcely be urged that the presence of phosphates constitutes an unmixed bless-

ing. W. Detmar (*Bied. Centr.* 1883, 71) is still more emphatic in his view, for he states that phosphoric acid, if present in worts in large quantities, completely destroys the action of the diastase.

So much, then, for the phosphates in malt and worts. Let us now proceed to ascertain the influence which they exercise upon the subsequent fermentation.

The preliminary experiments which we conducted upon this subject, were performed upon materials over which, we considered, we could exercise absolute control. We were anxious to eliminate every possible source of error, arising from the varying composition of commercial worts; and we therefore employed artificial nutritive media similar to that of which "Pasteur's solution" is a type. We added varying quantities of different phosphates to equal quantities of the same solution, fermented with the same amount of yeast in each case; and noted the variation which had been exercised upon the separate fermentation of each series, by estimating the amount of cane sugar which had been decomposed in a given time. This, of course, corresponds to the production of comparable quantities of alcohol during the same period; for we thought that we might disregard the energy involved in the inversion of the cane sugar by the yeast prior to fermentation, because the error, if any, was constant throughout. The sugar was, in each case, estimated gravimetrically by Fehling's solution. The solutions were thoroughly sterilised, and subsequently cooled, before the addition of the yeast. The vessels containing the varying quantities of phosphates in the artificial solutions were all kept under exactly similar conditions of temperature. The temperature of pitching was in all cases 60° F.

The amount of yeast added corresponded to 1½ lb. avoirdupois per barrel, which may be taken as the average quantity used upon the commercial scale.

The ingredients used in the preparation of the solutions were chemically pure.

Appended are some of the typical results actually obtained, together with details as to the varying quantities of solution and yeast employed, and as to the time during which fermentation was allowed to proceed:—

POTASSIUM PHOSPHATE.

Potassium Phosphate in solution, in grammes per 100cc.	Equal to P ₂ O ₅ in grammes per 100cc.	1st Series. Sugar used, grammes per 100cc.	2nd Series. Sugar used, grammes per 100cc.	4th Series. Sugar used, grammes per 100cc.
0·0000	0·0000	9·4604	8·5770	5·6352
0·0575	0·0192	9·4920	8·5896	6·5054
0·1150	0·0385	9·8740	8·5001	6·9448
1·1720	0·0577	—	8·7666	—
0·2300*	0·0770	10·1070	9·6884	6·9228
0·2875	0·0962	9·1934	9·9124	—
0·3450	0·1155	8·6677	7·7586	6·3160
0·4025	0·1348	8·5644	7·5948	6·2002
0·4600	0·1541	8·0474	7·8878	5·2820
0·5175	0·1733	8·3662	7·2850	4·6089
* Quantity normal to Pasteur's solution.		100cc. solution, 5grm. yeast, Time, 18 hrs.	100cc. solution, 5grm. yeast, Time, 18 hrs.	300cc. solution, 1·01grm. yeast, Time, 60 hrs.

CALCIUM PHOSPHATE.

Phosphate of Calcium, in grammes per 100cc.	Equal to P ₂ O ₅ in grammes per 100cc.	Sugar used, in grammes per 100cc.
0·0000	0·0000	7·8746
0·00375	0·0026	7·8314
0·01150	0·0052	7·8213
0·01725	0·0079	7·8056
0·0230*	0·0105	7·6936
0·02875	0·0131	7·6936
0·03450	0·0177	7·6504
0·04025	0·0184	7·2456
0·04602	0·0211	—
0·05175	0·0237	7·9604
0·2070	0·0948	6·7114
* Normal.		3rd Series, 300cc. solution, 1·01grm. of yeast, Time, 60 hours.

In this experiment the normal amount of potassium phosphate was present in addition to the calcium phosphate.

MAGNESIUM PHOSPHATE.

Phosphate of Magnesium, in grammes per 100cc.	Equal to P ₂ O ₅ in grammes per 100cc.	Sugar used, in grammes per 100cc.
0·0000	0·000	4·9972
0·0575	0·003	4·7558
0·01150	0·006	4·1440
0·01725	0·009	4·1284
0·0230	0·012	4·2562
0·02875	0·015	4·1852
0·03450	0·018	4·3078
0·04025	0·021	3·9200
0·04602	0·024	4·6376
0·05175	0·027	4·2562
		300cc. solution, 1·01grm. of yeast, Time, 60 hours.

In this experiment the amounts of potassium and calcium phosphates, normal to Pasteur's solution, were employed in addition to the magnesium phosphate.

Now, whatever may be the value attaching to these preliminary experiments, from the practical brewers' standpoint, it will not be denied that they possess a certain value; for they show, clearly enough, that the presence of a certain amount of potassium and calcium phosphates is advantageous in promoting the decomposition of cane sugar by yeast in a given time; and that beyond a certain limit, which very nearly approaches the normal amount of such bodies prescribed by Pasteur for addition to his solution, a decided decrease takes place in the amount of cane sugar so decomposed. They further show that the addition of magnesium phosphate to such solutions is of no use; inasmuch as it would appear to be practically inert as regards the decomposition of cane sugar in a given time.

We have next to decide whether a similar result attends the introduction of such phosphates, and of other forms of phosphates, into worts prepared in the brewhouse for conversion into beer.

In order to arrive at a satisfactory conclusion in the matter we have proceeded as follows :—

In all cases commercial worts were employed—*i.e.*, worts obtained from breweries, and prepared for fermentation with a view to the production of beer. Much larger quantities were operated upon than in the preliminary experiments, no less than 1000cc. being used in each case. The yeast was also what may be termed commercial yeast—*i.e.*, it was fresh yeast, actually used in brewing operations. It was always freed from associated liquid by pressure prior to pitching, but the pressure was never allowed to be sufficient to injure the cells. In every case a microscopic examination of the yeast and measurement of the cells were made prior to use. If any cells were burst the samples were rejected, and a similar treatment followed the discovery of any dead or weak cells, as disclosed by staining with soluble aniline blue.

The wort was always examined microscopically prior to use, and if impure was rejected; if pure, it was heated to 75° C. for some time, and then cooled down to 15° C. It should be added that the wort was always obtained by us after it had been passed through the refrigerator, so that it had been both boiled and hopped.

After the wort had been cooled, it was thoroughly mixed, a portion retained for immediate analysis, and three separate quantities of 1000cc. each introduced into large open-mouthed glass vessels (resembling fermenting tuns in shape), kept as nearly as could be under identical conditions of temperature, and certainly under conditions favourable to fermentation. The vessels were numbered. To the first *no* combination of phosphorus was added; to the second was added sufficient of the combination to produce the equivalent of P_2O_5 of soluble phosphate in normal Pasteur's solution; and to the third was added double that amount.

With each 1000cc. of wort, 3.5grm. of yeast (equal to 1½lb. avoirdupois per barrel) were then mixed, and fermentation was allowed to proceed during forty-eight hours. We found this time best suited to the manipulation of such comparatively small quantities of wort; although we did not find any variation in the ultimate results by allowing a longer period of time for fermentation.

The three vessels being under identical conditions, containing equal amounts of wort, equal amounts of yeast, and only varying in the amounts of phosphorus which they contained (which amounts we had under our own immediate control), we were in a position to note the comparative effects produced by increasing quantities of the phosphorus combination.

At the conclusion of the fermentation a measured quantity of beer from each vessel was passed through a fine filter, after well stirring up the beer and yeast in the vessel; and the yeast, so obtained, was calculated after making due corrections for moisture. The results thus obtained as to yeast quantity were necessarily very inaccurate; but they furnished us with *comparative* results of great value.

The remainder of the beer from each vessel was filtered, and a measured quantity retained for analysis.

The yeast, after fermentation, was examined under the microscope, and the *comparative* size of the cells noted.

We considered it necessary, for the purposes of this research, to obtain answers to the following questions :—

(1.) Does the addition of any combination of phosphorus to a beer-wort cause any more phosphorus to be removed from the wort during fermentation, than would be removed if no such phosphorus were added?

(2.) Does the addition of phosphorus, in combination, to a wort cause a greater amount of soluble nitrogenous matter to be removed, or assimilated, during fermentation, than if no combination of phosphorus were added?

(3.) Does the addition of phosphorus, in combination, to a wort cause the production of a greater amount of alcohol in a given time, than would be the case if no such phosphorus were added? In other words, does it produce a more rapid attenuation of the wort?

(4.) Does the addition of phosphorus, in combination, to a wort effect an increase in the amount of yeast produced in a given time?

(5.) Is the yeast so produced better adapted for pitching purposes than if no such phosphorus were added? In other words, is it more vigorous and has it assimilated any of the elements necessary to its growth in greater quantity than would otherwise have been the case?

Unless some, or all, of these questions could be answered in the affirmative, we hold we are justified in concluding that, for the purposes of the brewer, the addition of phosphates to fermenting worts is unjustifiable.

We attempted to obtain answers to these questions in the following manner :—

The wort, before being fermented, was examined :—

1. For gravity.
2. For nitrogen.
3. For phosphorus (as P_2O_5).

4. The amount of yeast added was noted, and the size of the cells measured.

The resulting beers were examined for :—

1. Alcohol per cent. by weight.
2. Nitrogen.

3. Phosphorus (as P_2O_5).

4. Weight of yeast produced, and size and condition of growth of resulting cells.

Unless a greater quantity of yeast resulted from the addition of phosphorus, the first question, as to the amount of phosphorus assimilated by the yeast, would certainly be answered by estimating the P_2O_5 in the wort, and comparing the amounts contained in the three beers produced from it. If, on the other hand, more yeast were produced, more phosphorus would be required, and the result would point in favour of the use of phosphates.

The estimation of nitrogen is of the greatest value, because it settles the question of yeast production. M. Delbrück and others (*Bied. Centr.* 1880, 217-222) have found as the result of a very beautiful investigation, that the chemical composition of a definite sample of pitching yeast remains absolutely constant during its development in the wort; and that the new yeast produced is identical in chemical composition with the old, so that the amount of nitrogen removed from a wort during fermentation, becomes an exact measure of the amount of yeast produced during that period. They find this process exceedingly accurate, and further add that the formation of the yeast-cells has practically no connection with the visible working of the wort.

We may state at once that in no case did we find any alteration in the size and condition of the yeast-cells, upon the addition of phosphorus combinations, unless we added a great excess, when we found the cells to be stunted in growth and shrivelled.

ORTHO-PHOSPHORIC ACID.									
	WORT.				BEER.				
	1.	2.	3.		1.	2.	3.		
Sp. gr.	1.0578	1.0587	1.0595	Alcohol percent. by weight	4.57	4.20	4.02		
P ₂ O ₅ per 100cc.	.145	.209	.281	P ₂ O ₅ per 100cc.	.107	.172	.249		
N. " "	.111	.116	.114	N. " "	.076	.092	.093		
Weight of dry yeast taken	1.04	1.04	1.04	Wgt. of dry yeast produced	5.473	5.330	5.976		
No. 1 had no phosphoric acid added.				Grm.		No. 1. N. removed		Grm.	
" 2 had 1.06gm. phosphoric acid added.				No. 1. P ₂ O ₅ removed... .038		" 2. " "		.035	
" 3 had 2.12gm. phosphoric acid added.				" 2. " "		" 3. " "		.024	
				" 3. " "		" 3. " "		.021	
META-PHOSPHORIC ACID.									
	WORT.				BEER.				
	1.	2.	3.		1.	2.	3.		
Sp. gr.	1.028	1.029	1.029	Alcohol percent. by weight	1.83	1.89	1.73		
P ₂ O ₅ per 100cc.	.079	.127	.182	P ₂ O ₅ per 100cc.	.051	.115	.167		
N. " "	.034	.069	.064	N. " "	.030	.033	.055		
Weight of dry yeast taken	1.03	1.03	1.03	Wgt. of dry yeast produced	2.118	1.817	1.574		
No. 1. Meta-phosphoric acid				Grm.		No. 1. N. removed		Grm.	
" 2. " "				No. 1. P ₂ O ₅ removed... .028		" 2. " "		.024	
" 3. " "				" 2. " "		" 3. " "		.036	
				" 3. " "		" 3. " "		.009	
POTASSIUM PHOSPHATE.									
	WORT.				BEER.				
	1.	2.	3.		1.	2.	3.		
Sp. gr.	1.0481	1.0500	1.0510	Alcohol percent. by weight	3.78	3.73	4.02		
P ₂ O ₅ per 100cc.	.127	.291	.346	P ₂ O ₅ per 100cc.	.100	.277	.344		
N. " "	.121	.125	.131	N. " "	.050	.058	.056		
Dry yeast added	1.1145	1.1145	1.1145	Dry yeast produced	6.659	6.893	6.858		
No. 1. Potassium phosphate.....				Grm.		No. 1. N. removed.....		Grm.	
" 2. " "				No. 1. P ₂ O ₅ removed... .027		" 2. " "		.071	
" 3. " "				" 2. " "		" 3. " "		.067	
				" 3. " "		" 3. " "		.075	
MAGNESIUM PHOSPHATE.									
	WORT.				BEER.				
	1.	2.	3.		1.	2.	3.		
Sp. gr.	1.0892	—	—	Alcohol percent. by weight	4.82	5.32	5.20		
P ₂ O ₅ per 100cc.	.180	—	—	P ₂ O ₅ per 100cc.	.159	—	—		
N. " "	.266	.269	.260	N. " "	.166	.175	.174		
Dry yeast added	—	—	—	Dry yeast obtained	—	—	—		
No. 1. Magnesium phosphate				Grm.		No. 1. N. removed.....		Grm.	
" 2. " "				No. 1. " "		" 2. " "		.100	
" 3. " "				" 2. " "		" 3. " "		.094	
				" 3. " "		" 3. " "		.086	
MAGNESIUM PHOSPHATE DISSOLVED IN SULPHUROUS ACID.									
	WORT.				BEER.				
	1.	2.	3.		1.	2.	3.		
Sp. gr.	1.044	1.046	1.049	Alcohol percent. by weight	3.37	3.20	—		
P ₂ O ₅ per 100cc.	.107	.172	.250	P ₂ O ₅ per 100cc.	.082	.156	.271		
N. " "	.091	.109	.096	N. " "	.056	.067	—		
Dry yeast added	1.16	1.16	1.16	Dry yeast obtained.....	6.252	5.355	1.991		
No. 1. Magnesium phosphate				Grm.		No. 1. N. removed		Grm.	
" 2. " "				No. 1. P ₂ O ₅ removed .025		" 2. " "		.035	
" 3. " "				" 2. " "		" 3. " "		.042	
				" 3. " "		" 3. " "		—	

CALCIUM PHOSPHATE.									
	WORT.				BEER.				
	1.	2.	3.		1.	2.	3.		
Sp. gr.	1·0839	—	—	Alcohol percent. by weight	3·43	4·14	4·02		
P ₂ O ₅ per 100cc.	·193	—	—	P ₂ O ₅ per 100cc.	·153	—	—		
N. " "	·020	—	—	N. " "	·015	·016	·015		
Dry yeast used	1·2102	—	—	Dry yeast produced.....	5·043	—	—		
No. 1. Calcium phosphate added.....	Grm. 0·00			No. 1. P ₂ O ₅ removed	Grm. ·04				
" 2. " " "	1·68			N. removed	Nc increase.				
" 3. " " "	3·36								
AMMONIUM PHOSPHATE.									
	WORT.				BEER.				
	1.	2.	3.		1.	2.	3.		
Sp. gr.	1·0451	1·0459	1·0469	Alcohol percent. by weight	3·43	3·37	3·49		
P ₂ O ₅ per 100cc.	·079	·171	·265	P ₂ O ₅ per 100cc.	·071	·139	·245		
N. " "	·104	·130	·150	N. " "	·061	·082	·118		
Dry yeast added	1·0260	1·0260	1·0260	Dry yeast obtained.....	5·527	6·352	6·568		
No 1. Ammonium phosphate added.....	Grm. 0·00			No. 1. P ₂ O ₅ removed	Grm. ·008			No. 1. N. Removed ...	Grm. ·043
" 2. " " "	1·6			" 2. " " "	·032			" 2. " " "	·048
" 3. " " "	3·2			" 3. " " "	·020			" 3. " " "	·038
AMMONIUM-MAGNESIUM PHOSPHATE.									
	WORT.				BEER.				
	1.	2.	3.		1.	2.	3.		
Sp. gr.	1·0479	1·0480	1·0482	Alcohol percent. by weight	3·73	3·78	3·37		
P ₂ O ₅ per 100cc.	·077	·117	·115	P ₂ O ₅ per 100cc.	·059	·127	·204		
N. " "	·109	·112	·121	N. " "	·067	·074	·087		
Dry yeast added	1·05	1·05	1·05	Dry yeast obtained.....	—	—	—		
No. 1. Ammonium-magnesium phos- phate added.....	Grm. 0·00			No. 1. P ₂ O ₅ removed... ..	Grm. ·018			No. 1. N. removed ...	Grm. ·042
" 2. " " "	1·60			" 2. " " " } An in-	"			" 2. " " "	·038
" 3. " " "	3·20			" 3. " " " } crease.	"			" 3. " " "	·034

The combinations of phosphorus with which we worked were the following:—

1. Ortho-phosphoric acid.
2. Meta-phosphoric acid.
3. Potassium phosphate.
4. Magnesium phosphate (a) in powder.
(b) dissolved in sulphurous acid.
5. Calcium phosphate.
6. Ammonium Phosphate.
7. Ammonium-magnesium phosphate.

The most reliable, and the most typical, results obtained by us are shown in the tables on this and previous page.

There can scarcely be two opinions as to the interpretations which should be placed upon the results, which we have obtained, and so far as the matter has been investigated by other chemists, their observations tend precisely to the same conclusions as our own. Thus:—

M. Hayduck (*Bied. Centr.* 1881, 782) finds that fermentation is retarded by 4 per cent. to 5 per cent., and is suppressed by 1·3 per cent. of phosphoric acid.

W. Detmer (*Chem. Centr.* 1882, 461) finds that concentrated phosphoric acid is destructive of ferment life.

A. Mayer (see Thausing, p. 536) states that it is

potassium phosphate which furnishes the nutriment to yeast; and that its place cannot be supplied by any other phosphate.

We are now in a position to summarise the results of our experiments as follows:—

1. There is no relation to be found between the phosphorus and nitrogen of a malt, or of a wort prepared from such malt.

2. The amount of phosphorus in a malt, and consequently in a wort, is a very variable quantity. There is no evidence to show that a large amount acts beneficially, either upon the wort itself, or its subsequent fermentation; but there is abundant evidence to show that its effect is decidedly injurious to both.

3. The presence of increasing quantities of phosphoric acid does not increase the growth of yeast, as indicated by the size or appearance of the cells beneath the microscope, or by the amount of nitrogen removed from the wort, which amount has been found to be a rigid measure of the yeast-growth. On the contrary, a decrease in such quantities occurs, and further, no more phosphorus is assimilated by, or removed from, the yeast than would have been the case if no artificial addition of phosphoric acid had been made.

4. The same remarks apply to the effect of increasing quantities of potassium and of calcium phosphates;

also of magnesium phosphate, and of magnesium phosphate dissolved in sulphurous acid.

5. The addition of ammonium phosphate, and of ammonium-magnesium phosphate, causes a slight increase in the amount of P_2O_5 removed, or may be assimilated, during fermentation; but there is no evidence to prove that it exercises any improvement in the yeast-growth. On the contrary, the amount of nitrogen removed does not increase, as it should do, if the yeast-growth underwent any variation favourable to the use of such phosphates, and the attenuations do not point to a marked increase of alcohol in a given time.

6. Ammonium phosphate and ammonium-magnesium phosphate are the only two combinations which can be said to effect any improvement at all; and in any case it is so slight as to be almost negligible.

7. The amount of phosphorus required for assimilation during fermentation is very small, and, as a rule, very much less than the nitrogen weight for weight.

8. The amount of phosphorus present in worts, made from malt alone, and in worts containing added brewing sugars, is always, so far as we can ascertain, in excess of the quantity assimilated by the yeast, during the normal period of fermentation.

When first we announced our preliminary experiments upon this subject it was claimed that they were incomplete; and would not apply to the work of the brewhouse, inasmuch as they were not performed upon materials actually employed in the brewery. We were well aware at the time of the difficulties in the way of making the experiments upon worts; but we have ventured to overcome them, with a view to afford the brewer the information necessary to enable him to form a reliable opinion as to the merits of a question, which exercises much more influence upon his operations than he may hitherto have been prepared to admit.

If we have succeeded in this endeavour, we shall consider ourselves well repaid for the time, and trouble, we have expended upon the experiments.

DISCUSSION.

Dr. GRAHAM said: In calling upon those, who desire to discuss the valuable paper we have had the pleasure of hearing this evening, I take the opportunity of remarking that the very many representatives of the brewing and allied industries present, prove that, at the establishment of the Society of Chemical Industry, we did well to include fermentation processes among the subjects of applied chemistry, which the Society was established to study and promote. Brewing, distilling, and other industries allied to these, are well represented among the members of our already large Society, and as there are many present to-night specially competent to discuss the authors' contribution to the chemistry of fermentation, I have much pleasure in now asking them to do so.

Mr. CHARLES F. THATCHER, speaking as a practical brewer, and from the experience gained during the last eighteen or twenty years, said: Some years since, when in the West of England, I was advised by a well-known authority on brewing to use bone ash as a yeast-food or stimulant; after giving it a comparative trial, extending over some weeks or months, failing to trace any direct beneficial result I discontinued the use of it. Now, with regard to Smyrna malt, I have had, I believe, a rather exceptional experience, as at the brewery before alluded to I produced all classes of ale and stout for a period of over nine months with *Smyrna malt alone*, combined with a certain percentage of *levo-* or *dextro-saccharum*. The reasons which induced me to adopt

this course were, first, economy; and, secondly, the satisfactory nature of the article produced. I believe I am correct in stating that the same principles are still continued at the brewery I refer to. An important point, as bearing upon the subject before us, is, that I always found the yeast obtained from fermenting wort in which Smyrna malt was employed, both vigorous, well-developed, and solid in character, and also abundant in quantity; therefore, taking into consideration the fact, as stated by Messrs. Salamon and Mathew, that this malt contains only a small percentage of phosphates, as compared with English malt, I think we may fairly assume, that beyond a certain point, phosphates are not necessary to the production and development of the yeast plant.

Mr. SHEARER: It would be interesting to know whether Messrs. Salamon and Mathew had made any experiments with the view of determining the vigour of the yeast crops obtained in their miniature fermentations. The production of yeast fitted for continuing the successive fermentations was, to the brewer, a matter of the highest importance; and although fermentation was carried on with the object, primarily, of converting sugar into alcohol, the operation was one which by the formation of a yeast, vigorous and otherwise suitable, the continuance of the brewing operations in the immediate future depended. The authors of the present paper appear to have depended solely upon the measurement of the cells and their hereditary characteristics, as evidences of the fitness of the yeast for future pitching purposes. Would it not be desirable to have the more direct testimony afforded by pitching the collected yeast once more in wort and recording the results? In the first series of experiments, the authors dealt only with the effects of phosphates added in various proportions to what is known as Pasteur's solution. The results they obtained, upon fermenting the solutions just mentioned, the authors have expressed in terms of sugar decomposed, and although for many technical purposes this method expresses with sufficient accuracy the relative vigour of the yeast dealt with, yet it is to be regretted, in view of the disturbing influences likely to be present when carrying on fermentations upon such a small scale, that Messrs. Salamon and Mathew did not, in addition, record the increase in weight of yeast at the conclusion of each fermentation. The greatest objection to be raised to the first series of experiments was, however, connected with the nature of the solutions fermented. In the fermenting fluids were to be found none of the bodies present in the wort actually produced in the brewery. Albumenoids, peptones, principles derived from the hops, carbohydrates, even maltose, etc., were absent, so that little of practical utility could be adduced from the experiments, however interesting in themselves. We have to thank Messrs. Salamon and Mathew for continuing their experiments under conditions more closely approaching to those existing in the brewery. In the face of the results obtained, from which the authors draw the conclusion that the amount of P_2O_5 existing in the ordinary wort of the brewer (wort of about 1'060 sp. gr.) is always rather in excess of what is desirable for the most favourable results in the way of yeast development; it would be interesting to learn how these gentlemen can explain the apparent anomaly that yeast, which from any cause has become weakened, if pitched in *strong* wort, much stronger than ordinary, or normal 1'060, wort, is greatly strengthened, and that generally fermentations are more vigorous when yeast is pitched in a very strong wort, than when the same yeast is employed to excite fermentation in one of normal gravity. Yet accord-

ing to the deductions drawn from Messrs. Salamon and Mathew's results, wort of a gravity of 1.120, containing double the proportion of phosphoric anhydride, as compared with ordinary wort, and, therefore, a very undesirable excess of that body, would be ill fitted for the carrying on of a strong and powerful fermentation. As a matter of fact, however, brewers are in the habit of using strong wort for the purpose of invigorating weak yeast, and also for inducing a strong fermentation prior to pitching the bulk of the wort to be fermented. Messrs. Salamon and Mathew's statement that the P_2O_5 in the ash of yeast is present mainly as phosphate of potash may possibly be correct; but, if so, the phosphate must be of a very complicated formula, one that has hitherto been unknown, the ratio subsisting between the phosphoric anhydride and the potash not admitting of the acid and base being united to form any ordinary phosphate of potash.

Dr. E. R. MORITZ said: From the results of Messrs. Salamon and Mathew's investigation, it appears that the addition of phosphates to the fermenting wort causes no increase in the quantity of nitrogenous matter absorbed by the yeast; but granting this to be so, there is yet one other point to be considered—viz., the quality of nitrogenous matter so removed. It has come under the notice of others and myself, that an addition of assimilable phosphates, applied in a manner specially adapted to the cases in question, has promoted the stability and clarification of beers, which without this addition were found deficient in these respects. This property has been most marked in the case of beers brewed with soft waters (especially those containing carbonate and sulphate of soda) and malts insufficiently exposed to high temperatures on the kilns. In the ordinary way, these circumstances would tend towards unstable and cloudy beer, but the addition of phosphates previous to the fermentation was found to produce a marked benefit as regards stability; and the conclusion to be drawn would be that the added phosphates, if not stimulating the yeast to absorb greater amounts of nitrogenous matter, caused it to assimilate that kind which specially favours the development of the microbes of beer disease.

Dr. W. S. SQUIRE said he fully agreed with Mr. Salamon in his view that malt worts contained sufficient mineral constituents for the growth of yeast. Pressed yeast contains from seventy to eighty per cent. of water, and the solid substance of yeast contains from six to seven per cent. of ash, consisting mainly of phosphate of potassium, with a certain quantity of the phosphates of magnesium and calcium; so that pressed yeast does not contain more than about two per cent. of ash. It happens that the composition of the ash of malt resembles in a rough sort of way that of the ash of yeast, and of this ash, malt contains about two per cent. It is evident, then, that if the whole of the mineral constituents of the malt passed into solution, they would be sufficient to produce a weight of pressed yeast equal to that of the original malt. Of course, the whole of these mineral constituents does not pass into solution, but a considerable proportion does. It is chiefly the calcium and magnesium salts which remain behind, while the greater part of the phosphate of potassium dissolves. In any case, the wort will contain mineral matter amply sufficient for the quantity of yeast which would be obtained under normal circumstances. Of course, this would be somewhat different if large quantities of sugar containing little or no phosphates were added to the wort. I am speaking of beer worts, and a fermented solution of sugar is not, in my opinion, beer. Even in distilleries where a considerable proportion of raw grain is used in the com-

position of the worts, a very large crop of yeast, as much as eight or nine per cent. of the materials used, may be obtained by particular management, without any addition of mineral matter. This is generally known as pressed or German yeast, and is in no way inferior to beer yeast, produced under the most favourable circumstances. On the contrary, it is far more active and healthy than beer yeast, and is on that account preferred by bakers and confectioners. I am, therefore, of opinion that the addition of phosphates is totally unnecessary for the manufacture of beer from malt and hops. What it might be necessary to add, when a fermented liquor other than beer (though bearing that name) is prepared from materials other than malt and hops, I am unable to say.

The CHAIRMAN said: It is now my pleasing duty to conclude the discussion. I think we must all be of opinion—no matter how we may differ in our interpretation of their bearing—that the authors have made a valuable contribution to the chemistry of fermentation. The numerous analyses made must prove of use to many of us hereafter for reference, and assistance in other work; and while I congratulate the authors upon their valuable work, I hope they will continue their investigations. In regard to the use of phosphates, I agree with the authors, at least with reference to worts from well-harvested barleys and well-grown malts, but where large quantities of sugars, whether cane, invert, or of starch origin, are used, I have found the occasional use of phosphates beneficial. The authors have misunderstood the bearing of the empirical deduction made by me from the moist combustion process as applied to malt worts and beers. This process gives results, which have no relation to those obtained by the soda-lime process, which, though not giving the absolute nitrogen in all cases, still gives much more than the Wanklyn method. In my experience of malt analyses, I have found the Wanklyn *albumenoids* to be a useful factor, taken with many others, in arriving at a practical conclusion as to the merits of various malts for different kinds of beers. I beg to move, gentlemen, that the thanks of this meeting be given to the authors for their valuable paper, which I hope may be followed by further contributions.

Mr. SALAMON said, in reply: The experience of Mr. Thatcher with Smyrna malt is of great interest, when considered with reference to our paper; because, as he states, it clearly shows that good results may be obtained from a malt abnormally low in phosphorus. It will also generally be found that the soluble nitrogen of a Smyrna malt is of low percentage; much lower indeed, in many cases, than the sample the analysis of which we have recorded. This would seem to give the key to the whole question—viz., that high soluble nitrogen and high phosphorus indicate a malt grown upon a highly cultivated land; but it by no means follows that such malt is the best for brewing purposes. Indeed, there is a very increasing opinion that much of our land is over-cultivated for purposes of barley growth. Smyrna malt is generally used, in this country, for blending. May it not be that one of its functions is to dilute the amount of phosphorus present in malts derived from very highly cultivated land? Mr. Shearer asks if we have pitched with the yeast obtained in our laboratory fermentations? I do not hesitate to say we have not done so. It would have been obviously ridiculous to have attempted to pitch upon such a scale with yeast so produced. If gentlemen present this evening have any doubt as to phosphate-treated wort producing better pitching yeast than ordinary wort, it would be well for them to repeat our experiments upon the large scale. It is in this way that the brewer

can lend a helping hand to the chemist. But it is necessary to see that the conditions are under control. For instance, I have been in several country breweries, where they looked favourably upon the addition of solutions of phosphates to fermenting worts. I questioned them as to their mode of use; and found that, in every case, they added them to the wort, when the attenuation was about half completed. In fact, they roused the solution into the wort, thus re-aërating it, and so re-invigorating the yeast. It is scarcely necessary to add that the appearance of a more vigorous crop of yeast does not, under such circumstances, indicate that it is due to the addition of phosphates; but it does show that no scientific attention was paid to the details of the work. If we have proved, that the addition of phosphates does not affect the size or appearance of the yeast cells, that the thickness of its walls remain unaltered; that no more, and sometimes less, alcohol is produced in a given time; that no more, and sometimes considerably less, nitrogen is removed from the wort, this nitrogen so removed having been found to be a rigid measure of the yeast produced; that no matter how much phosphorus is added, the same amount, or practically the same amount, is removed from the wort, and no more,—then, granting the accuracy of our observations, it would indeed require very strong practical testimony to effectually contradict them. The fact that weak yeast revives under treatment with strong wort is surely no proof that its revival is due to the presence of the phosphate. Mr. Shearer complains that our experiments upon Pasteur's solution were made under conditions which had no relation to malt worts in a brewhouse; that we did not in that instance take into consideration the influence of the carbohydrates and of the various nitrogenous constituents of a wort; but if his contention hold good in that case, it must be equally applicable to the one he cites; and I can best answer his question by asking him how he will deny the possibility of the increased quantity of these bodies providing additional nourishment for the yeast; and, moreover, holding the increased amount of phosphates in check, and thus preventing them from exerting any injurious influence. At any rate, we have proved that, under ordinary conditions, they do no good; and it is difficult to see why the experiment he cites should prove an exception to a rule which we have found to be so constant. Mr. Shearer is in error with respect to the phosphate of potash. We have only stated that it is generally returned as phosphate of potash existing in the ash; but inasmuch as we commenced by stating that the exact

condition of the existence of phosphorus in yeast was unknown, we have throughout alluded to it as phosphorus in combination. Dr. Moritz has alluded to experiments which he has made, inducing him to think that phosphates exert an action favourable to the removal of certain kinds only of nitrogenous matter. It is to be regretted that he has not seen fit to publish the result of these experiments; for if he has, as he states, made this discovery, he has mastered the very facts and gained the very information for which brewers have so long been waiting. If Dr. Moritz has found out what kind of nitrogenous combination it is, which produces stability in beer; and what kind it is that induces an opposite effect, then, in view of the importance of the subject, he is scarcely justified in keeping the information to himself; and I submit that he should be induced, at an early opportunity, to communicate the results of his experiments to this Society. If his remarks are merely inductive, and are not derived from absolute experiment upon the nitrogenous matter, then in view of the many experimental proofs we have offered to the contrary, and of the fact that he has submitted none at all in support of his contention, I do not think it will be necessary to trouble the meeting with further criticism respecting them. I am glad to find that Professor Graham's views upon the question of phosphates are practically identical with our own. As regards the matter of the soluble albumenoids, we are content to let our results speak for themselves. They were certainly made without bias on either side; and Mr. Wilson's past experience is certainly not to be ignored in the matter, especially as he states that in no case was there any room for hesitancy or doubt. I do not, however, wish to dogmatise upon a subject still involved in difficulties, and I hope that before long I may be in a position to contribute some further information bearing upon this question to the Society.

ADDITIONAL NOTE ON ALUMINA IN SUPERPHOSPHATE.

BY H. B. YARDLEY.

SOME time after the publication of my paper on this subject in the Society's Journal of August, 1884, it was suggested to me that a sufficient period had hardly elapsed between the tests of the mixtures.

Having the experimental samples still by me, I again retested the principal ones, with results stated in Table 1 as nine months after making. I also made the further experiments given in Table 2.

TABLE 1.

	Insoluble P_2O_5					Free acid, calculated as SO_3				
	No. 5.	No. 7.	No. 9.	No. 11.	No. 12 (with Fe_2O_3).	No. 5.	No. 7.	No. 9.	No. 11.	No. 12 (with Fe_2O_3).
Immediately after making...	0.17	0.35	6.80	0.40	1.71	8.67	3.94	0.48	not detd.	4.06
One month " "	0.23	0.48	9.16	0.35	2.43	8.18	3.75	0.48	"	2.58
Nine " "	0.17	0.84	10.80	0.40	3.43	7.72	3.76	0.55	3.36	1.58

TABLE 2.

Mixture.					No. 13.	No. 11 (similar to No. 7).
Grains pure tricalcium phosphate	...	...	...	...	200	200
" calcium carbonate	...	...	...	...	50	25
" alumina hydrate	...	...	...	...	22.5	12.5
" silica	...	...	...	...	22.5	12.5
					205.0	250.0
Grains chamber acid $115^\circ T$.	...	...	...	...	270.0	250.0

Gave on testing—

	Insoluble P_2O_5		Free acid, calculated as SO_3	
	No. 13.	No. 11.	No. 13.	No. 11.
Immediately after making	1.92	0.71	3.05	4.36
One month " "	2.04	0.81	2.47	4.00
Three months " "	2.45	1.02	1.28	3.20

All of these confirm the conclusion drawn in the first instance—viz., that *provided there is a sufficiency of free acid in the manure, no reduction takes place from the presence of alumina.*

In No. 13 the alumina will be seen to be in very large quantity (11½ per cent. in the phosphate) and the acid insufficient, hence the slight reduction in this case.

I may as well state that the free acid was determined by alkalimetry to complete neutrality as indicated by cochineal. In presence of iron and alumina there is always a faint cloudiness after the first few drops of alkali are added, which scarcely increases until the liquid becomes alkaline. In commercial superphosphates I have found this cloudy precipitate consists wholly of phosphate of iron, but in the experiments containing alumina a similar cloudiness occurred, which, however, I did not test, but the presumption is that it was phosphate of alumina, as those containing neither iron nor alumina gave no precipitate whatever until alkalinity was reached.

In conclusion, the condition of the samples No. 7, *et ult.*, was very good indeed, and even No. 5 was not so wet as might be expected from the large excess of acid.

DISCUSSION.

Mr. T. W. B. MUMFORD gathered from the author's figures, given now and in his former paper, that in the ordinary method of manufacturing superphosphates in saleable condition and free from excess of sulphuric acid, the presence of iron and (or) alumina in the raw material, tended after the lapse of a short time to render its equivalent of monocalcic or soluble phosphate insoluble. It certainly had been proved beyond question, whatever might be the deduction which the author could draw from his experiments, that when iron and (or) alumina were not present no diminution in the solubility of a superphosphate took place, even after storage for some years.

Mr. HUGHES asked whether the author considered that his experiments afforded evidence that alumina was an unobjectionable constituent of mineral phosphates in the face of the contrary view held by manufacturers at the present time. The figures on the board went to show that no reversion into the insoluble state took place so long as a large excess of "free acid" was present. What did the author mean by "free acid"? Surely 4 or 5% of free sulphuric acid would completely unfit a manure for storage, and indeed all agricultural purposes. What practical value could experiments have which depended on a physical condition of the superphosphate impossible in practice!



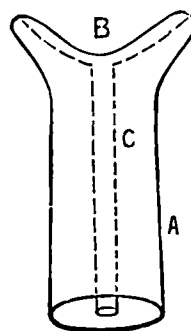
ON A NEW FORM OF PETROLEUM LAMP.

BY PERCY F. FRANKLAND, PH.D., B.Sc., F.C.S., ASSOCIATE ROYAL SCHOOL OF MINES.

THE rapid advances which have been made during the past twenty years in the construction of petroleum lamps has resulted in the almost exclusive use of mineral oil in all places where gas is either out of reach or not desired. The use of colza lamps in the house is now almost solely adhered to by timid persons who regard petroleum with suspicion, and who, therefore, prefer to remain satisfied with the inferior light, great cost, and unnecessary labour which lamps consuming vegetable oils entail. Colza and other fatty oils, however, still retain their place in lamps of another class, such as railway lamps, hand lanterns, and the like, owing to the difficulty which is experienced in burning mineral oils in places exposed to

draught and violent vibrations, or in lanterns in which the use of chimneys is inadmissible.

I have the pleasure of bringing before the notice of the Society a form of burner which has been specially designed for the consumption of mineral oil in lamps of this latter class, and which possesses some points of interest and novelty.



This burner consists of a hollow porcelain cylinder (A) from 2-3 inches in length, the upper extremity (B) of which is flattened and has a notch cut in it. The interior of this cylinder is fitted with a mixture of plaster of Paris and charcoal, and its axis is penetrated by a glass tube (C) about ½-inch diameter, which serves to hold the wick. This cylinder is cemented into a metal screw which fits on to the oil reservoir, so that the lower extremity of the cylinder almost touches the bottom of the reservoir. The wick used is a mere cotton string, the thickness of which is practically immaterial, and is so arranged as to very slightly project in two or more loops above.

When the lamp is first lit it burns but dimly, until the porcelain cylinder becoming strongly heated the flame gradually enlarges, expanding in the direction of the flattened upper extremity of the burner, the height of the flame depending upon the extent to which the wick projects. The flame produced is flat and slightly pointed towards the top, and the height should be so arranged that it is just below the smoking-point. When thus adjusted, the lamp continues to burn without any attention until the last drop of oil in the reservoir is consumed, the illuminating power remaining nearly constant throughout.

A charge of 4 fluid ounces of kerosene oil was found to last 13 hours, and the light yielded towards the end of this period amounted to 0.93 standard candle. In other words, 4 fluid ounces of kerosene when burnt in this lamp produce a light of one candle for 12.09 hours, or 1 gallon of oil will give a light of 48.4 candle-hours. The oil used was the best kerosene, flashing at 107° F., and obtainable for 10d. a-gallon; 48.4 candle-hours would thus cost 10d., or 12 candle-hours about one farthing. This is not so cheap as the light yielded by petroleum lamps provided with a chimney, for I found that the smallest and commonest lamp of this kind which I could purchase, in which the wick was ½-inch in width, consumed 4 fluid ounces of kerosene in 12.25 hours, giving during this period an average light of 1.44 candle; 1 gallon of kerosene burnt in such a lamp would give 706 candle-hours, or 12 candle-hours could be obtained at a cost of 0.17d.

I have also compared the cost of the light obtained from the new burner with that yielded by a colza-oil lamp without chimney. This lamp, which was provided with a ½-inch wick, was allowed to burn for thirteen hours, and at the end of four hours it was giving a light of 0.86 candle, whilst at the end of twelve hours the light had fallen to 0.21 candle. Assuming, how-

ever, that the light of 0.86 candle had been maintained for thirteen hours, then 4 fluid ounces would yield 12.92 candle-hours, and 1 gallon 517 candle-hours; taking the price of colza-oil to be 2s. 9d. a-gallon, the cost of 12 candle-hours would be 0.77d., or more than three times as much as the cost of the same light produced by the new burner with kerosene oil.

The new burner gives a flame which is not extinguished even when exposed to exceedingly violent vibrations and shocks, a circumstance which renders it particularly fitted for lanterns and carriage purposes. The light appears to be a perfectly safe one, and all experiments undertaken with a view to producing an explosion of the petroleum vapour and air inside the reservoir proved unsuccessful. Thus the burning lamp was heated in an air-bath so that the oil in the reservoir was at 138° F., and although the flame was violently blown about by the currents of air no flashing of the petroleum-vapour took place, notwithstanding that only a small quantity of oil had been put in the reservoir so as to leave a large air-space, and thus facilitate the formation of an explosive mixture.

A weak point in the lamp is that a small amount of petroleum-vapour escapes combustion and causes a slight smell; this is, however, of comparatively little importance, as the lamp is not intended for use indoors.

Liverpool Section.

Chairman: E. K. Muspratt.

Vice-Chairman: Prof. J. Campbell Brown.

Committee:

Eustace Carey.	A. Norman Tate.
John Hargreaves.	J. Allcock.
E. Milner.	J. C. Gamble.
C. Symes.	Douglas Herman.
P. Hurter.	Alexander Watt.
H. Brunner.	W. P. Thompson.

Local Sec.: E. G. Ballard, Queen's Park, St. Helens.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

UNIVERSITY COLLEGE, ASHTON STREET, LIVERPOOL.

MR. E. K. MUSPRATT IN THE CHAIR.

SUMMARY OF PAPER ON THE PRESENT POSITION AND FUTURE PROSPECTS OF ELECTRIC LIGHTING.

BY A. BROMLEY HOLMES, ASSOC. M. INST. C.E.

The author first pointed out the advantages of electricity over gas and oil as a source of light indoors, owing to the fact that no oxygen was consumed and all noxious products of combustion were avoided.

The manufacture of electricity on a large scale was stated to be much simpler than that of gas, the difficulties of electric supply being chiefly the absence of practical means of storage and the cost of distribution.

Primary batteries would be of great use in small installations, and the accumulators at present obtainable were very imperfect. Electrical engineers naturally looked to chemists for the improvement of primary and secondary batteries, and the progress made in this direction at present was lamentably small.

The methods of generating electricity for lighting purposes were explained, and the various classes of dynamos were described, together with the devices employed to make these machines self-regulating so

as to automatically adjust themselves to a varying number of lamps.

It was mentioned that machines were now made so perfect in this respect that it was possible to turn out 99 lamps out of a hundred without affecting the brightness of the remaining one lamp.

The storage cells at present in use were stated to consist generally of glass or earthenware vessels, containing in a dilute solution of sulphuric acid one or more pairs of lead plates, the surfaces of which have been oxidised by the action of an electric current or otherwise. The charging current from the dynamo causes the formation of peroxide on one plate, and reduces the surface of the other to a less oxidised condition. When the dynamo is disconnected, and the cells are coupled up with the lamps, the current flows in the reverse direction to that of the charging current. To increase the storage capacity of the lead plates, they are sometimes perforated, and the holes so formed filled up with oxide of lead.

The desiderata in an accumulator are, moderate first cost and reasonable durability, combined with a high electro-motive force, low internal resistance, and considerable storage capacity.

A hope was expressed that members of the Society of Chemical Industry would direct their attention to this important detail connected with the advance of electric lighting.

The principle of action of arc lamps and incandescent lamps was fully explained, and also the various plans of coupling up the lamps for work.

The difficulties connected with the distribution of electricity were alluded to, and also the means adopted to overcome these obstacles.

It was mentioned that the electric light was now being supplied from central stations at a cost from one and a-half times to twice that of gas of equal illuminating power, and the author indicated the directions in which the cheapening of the electric light was possible, and concluded by stating his belief that within a limited period incandescent lamps would be obtainable, so far improved in efficiency as to bring the electric light within the reach of all.

DISCUSSION.

Mr. SIMPSON said: He always had been surprised at the blind support given by the public to all sorts of electrical schemes, more especially in connection with accumulators. Sir Wm. Thompson had pointed out that in charging and discharging these latter there was a loss of power of about 25%; and in the case of truncars propelled by them this loss even amounted to 50%, without any counterbalancing advantage. Dynamos too seldom gave a return of more than 85% of the power expended. He would, however, be glad to see the large dynamos in use mentioned in Mr. Holmes' paper. He had himself gone to some expense in electrical experiments on caustic soda, but the want of a diaphragm capable of withstanding its action caused the experiments to be abandoned.

The CHAIRMAN asked Mr. Holmes if electric lighting had made commercial progress. He thought that in the future, electricity would play a part in chemical operations in spite of the unfortunate experience of workers like Mr. Simpson. A member, who had visited some electrolytic works in London, had been favourably impressed with what he saw there. Messrs. Siemens had also fitted up plant in Germany, by which electricity did the work of scrap-iron in the wet-copper process, but the large capital outlay required had hitherto prevented its adoption for that purpose in England. He had also read lately of an improved primary battery, of a portable nature, capable of supplying light on a small scale.

Mr. THOMPSON suggested the use of aluminium in primary batteries. By the action of caustic soda a very considerable temporary effect was produced, but the rapid destruction of the metal had hitherto stood in the way of complete success.

Mr. HOLMES, in reply, said that recent experience had hardly confirmed the anticipations formed with regard to accumulators. He had calculated that 18,000 tons of accumulators would be required to take the place of engines of 3000 horse-power in the case of Atlantic liners. With tramcars the case was better. To work a tramcar for five hours, a ton weight of accumulators would be needed, and would replace, say, two horses. To this must be added the weight of the dynamo, which was comparatively small. There was no reason why a tramcar should not carry storage batteries sufficient to propel it for three or four hours, and this had often been tested in practice in London and elsewhere. As to cost, a steam-engine was far more economical than horse-traction. Suppose that a steam-engine were put down at the tram stables to accumulate the electricity, they could change batteries as quickly as horses—even more so, were they to adopt the simple expedient of running the accumulators in trams under the cars.

Mr. SIMPSON: Would not compressed air do better?

Mr. HOLMES: The cost of plant had prevented this having a fair trial up to the present. Then, in Liverpool, see how the tramways were laid, and the cruel strain put upon the horses to start the cars, the latter of which would be obviated by the use of electricity. Mr. Simpson wished to know what horse-power would be required to work these large dynamos. The largest in Liverpool now was at Messrs. Tait's sugar refinery, and showed to what perfection these engines had been brought, for it started a month ago, had worked continuously ever since, and was in perfect order now. He thought that a machine capable of running 600 lights would soon be made. Messrs. Siemens would have in the Inventions Exhibition three dynamos, each producing 300 lights and driven direct by three pairs of high-pressure and low-pressure engines. In practice about eight lights could be run per horse-power. Regarding the commercial side of electric lighting, taking for granted that the steam-engine is about as good as it can be, and that water is to be had for the pumping, then the dynamo would utilise about 90% of the power, and no better than that could be done. As to the mains, there must be a central station, from which they should be laid so as to annihilate distance as much as possible. Edison had tried an ingenious plan called the "three-wire system," but in Liverpool it would be necessary to adopt the "parallel system" for simplicity's sake. Even with this occasional breakdowns occurred, as in everything where dependence had to be placed on inexperienced persons. As to the incandescent lamp, he believed it had a great future, but there was great scope for economy yet. The cost per light could be reduced to one-half of that formerly incurred.

Manchester Section.

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Vice-Chairman: J. Lovinstein.

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H. Grimshaw.
H. W. Gerland.
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T. Jackson.

D. B. Howitt.
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Watson Smith.
L. Siebold.
Wm. Thomson.
D. Watson.

Local Secretary:

J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

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W. W. Proctor.
J. F. Stark.
T. W. Stuart.

Local Secretary and Treasurer: J. T. Dunn, 115, Scotswood Road, Newcastle.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

ERRATUM.—In the May number, vol. iv. [5] 312, nineteenth line from top of first column, for "multiplied by two," read "multiplied by four."

Birmingham and Midland Section.

Chairman: Alexander M. Chance.

Vice-Chairman: W. A. Tilden.

Committee:

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C. O'Sullivan.
L. Percival.
H. Peyton.
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G. Shaw.
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W. A. Wiggin.

Hon. Treasurer: Charles Hunt.

Local Secretary:

A. BOSROCK HILL, 11, Temple Street, Birmingham.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Glasgow and West of Scotland Section.

Chairman: J. Nelson Cuthbertson.

Vice-chairman: E. J. Mills.

Hon. Vice-chairman: E. C. C. Stanford.

Committee:

George Bellby.
J. Y. Buchanan.
T. Carnelley.
J. Christie.
W. J. Chrystal.
W. J. A. Donald.
J. Ferguson.
J. Fyfe.

J. Napier.
T. L. Patterson.
R. Pullar.
J. B. Readman.
F. J. Rowan.
H. R. Tatlock.
W. Wallace.

Hon. Treasurer:

J. J. Coleman, 45, West Nile Street, Glasgow.

Local Secretary:

G. G. Henderson, Chemical Laboratory, University of Glasgow.

Notices of papers and communications for the Meetings to be sent to the Local Secretary.

Nottingham Section.

Chairman: Professor Frank Clowes.

Vice-Chairman: Lewis T. Wright.

Treasurer: J. B. Coleman.

Committee:

L. Archbutt.
W. H. Curry.
W. A. Curry.
H. Dudge.
S. E. Field.
R. Fitzhugh.

W. Jennings.
H. J. Staples.
E. B. Truman.
J. F. Warwick.
H. L. Whitoley.

Hon. Local Secretary:

J. R. Ashwell, Midanbury Lodge, Bentinck Road, Nottingham.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

INAUGURAL MEETING.

The proceedings of this Section were inaugurated on Friday, June 5, by a *Conversazione*, in the University College, Nottingham, which attracted a

numerous assemblage. In the Chemical Laboratory was placed a series of exhibits collected by the various members of the local committee, illustrating some of the industries comprised in the Society's programme, and which included various methods of lighting by gas and electricity, coal-tar and other colours, analytical and optical apparatus, and many other objects of chemical and scientific interest, all of which reflected great credit on their exhibitors.

At eight o'clock an inaugural address was delivered by the Chairman, Professor Clowes, in the large lecture theatre of the College.

Professor Clowes said: It falls to my lot, as the present representative of the Nottingham Section of the Society of Chemical Industry, to address a few words to you this evening. And speaking, as I do, not only to members of this young, and I trust vigorous Society, but to friends who have honoured us with their presence, my first duty is certainly to give to our guests in the name of the Society a most sincere and hearty welcome. We will venture to hope that many of you will, at future gatherings of this kind, have exchanged your present condition of guests for that of entertainers—a change which our Secretary will, I am sure, do his utmost to facilitate. And now, speaking to a gathering of friends interested in the progress and welfare of chemistry and of chemical industries, and met together in this capacity probably for the first time, and in a somewhat informal manner, I trust you will allow me to depart from the formality of an ordinary President's inaugural address, and to state to you in a brief and simple manner our reasons for starting this Society, and the directions in which we hope and expect that it will be useful to Nottingham and the surrounding towns and district. History tells us that in early times men worked most indefatigably, but in a somewhat haphazard manner, to improve and discover various processes of manufacture; their main object being, not so much the discovery of the secrets and laws of nature and the benefit of mankind, as the improvement of their own finances. In later ages many men of energy and intellect have placed before themselves in their labours a more lofty and less selfish aim; they have spent themselves in attempting to learn what are the unchangeable laws of nature. At first sight it might appear that these two classes of workers had little in common; and, unfortunately, this opinion has always in some degree existed,—the natural philosopher engaged in prosecuting his researches being almost contrasted with the energetic and intelligent manufacturer endeavouring to improve and discover processes; or, as it is put in the present day, the *theoretical* man is too often considered to be out of touch with, and to have nothing in common with, the *practical* man. It must, however, be very evident to those who will carefully consider the case, that the interests of both these classes of workers are to a great extent identical: thus, only can the practical man work most surely, most directly, and most economically when he works with a knowledge of nature's laws; equipped with this knowledge also, he is in a better position to insure advance and improvement. We are told on the highest authority that England is suffering in competition with some of her Continental neighbours, by not appreciating as fully as they do the advantage of blending theory with practice, and the necessity of the co-operation of the scientific and practical man. In what way it is best to blend in chemical training the scientific and the technical elements, will certainly be debated in our new Nottingham Section of the Society of Chemical Industry, as it has been already discussed in many other similar societies in this country. I may therefore leave this

subject for the present, with the remark that it is one of paramount importance to the success of this town, and of the greatest interest to me personally in my capacity of a chemical teacher in your midst. But fortunately there are already in Nottingham and its neighbourhood men who fully appreciate the importance of enabling the rising generation to engage in our important industries with a knowledge of the scientific principles which underlie them, and who desire to aid this enterprise by every possible means; there are also not a few who have already passed through a very creditable scientific training in this building or elsewhere, and we have several gentlemen here this evening who are carrying on large and important industrial enterprises with a sound knowledge of scientific laws and principles. Representative men of these various classes have agreed that by associating themselves together, and bringing forward for discussion matters of novelty and importance, much may be done towards mutually aiding and informing one another, and towards arousing and stimulating a desire for the advantageous blending of theory with practice. Nottingham has already societies of a scientific character. The one which appears to be most nearly allied to our own is that known as the Chemists' Association. Its main object is, I believe, to secure efficient training to the pharmaceutical apprentices of this town, and those who best know the important and necessary work it is doing will most earnestly support this Association and endeavour to secure its permanency. But it will be evident to you that our Society should embrace many applications of chemistry besides pharmacy, and should gather in the trained and experienced as well as the student and the novice. There is then, as far as I can see, no existing association in this district with which we shall compete, whilst there are several societies, many members of which we should embrace. In comparison with the largest industrial centres of this country, Nottingham of course does not contain a numerous population, but the size of our town is decidedly respectable; it has increased considerably of late, and we are loyal enough to believe it will yet increase much more largely. Still, the question has been asked, Can we maintain a Section of the Society of Chemical Industry? I am sanguine enough to say undoubtedly we ought to do so, and that we will certainly make the attempt. But fortunately we have this great advantage, that we can start in connection with a large and important Society already organised, which will aid us financially, by its prestige, and still more by furnishing each of our members with a monthly Journal, which is unequalled as a record of the industrial chemistry of the civilised world. This Society further accords to each member of the Nottingham Section the privilege of attending its own meetings in London, as well as the sectional meetings in other large towns in the United Kingdom. We are therefore members of a large confederation, whose object it is to study, discuss and record the improvements and progress in applied chemistry, and in all matters related thereto; and I need not point out to you how greatly this may further our own personal ends, and, better still, how it may promote the efforts now being made to promote and maintain the supremacy of this country in the many industries involving the application of chemistry. For personal, as well as for patriotic reasons, this Society has therefore powerful claims on your co-operation and support. Some of you may ask what industries in the Nottingham district are capable of being advanced by a knowledge and application of chemical principles. Well, really the difficulty in answering this question arises rather

from the doubt as to which industries can fairly be omitted. However, to name some of the principal, we have the manufacture of gas and the utilisation of its residuals, the bleaching and dyeing processes, colour making, pharmacy, brewing, baking, tanning, iron smelting, coal mining, and, as I have already said, a host of others in which chemical knowledge must be of great advantage. But whilst chemical principles are thus widely applicable, it will be readily granted that applied chemistry cannot be divorced from scientific chemistry, from physics, and from mechanics, and we therefore invite and welcome into our Society those who can best aid our discussions from the physical and mechanical side, although our discussions will probably mainly be on applied chemistry. And I therefore do not hesitate, in the name of the Society, to invite communications of a purely scientific character, as well as papers on applied physics and mechanics. Our vast metropolis may support separate and distinct associations of scientific chemists, industrial chemists, scientific physicists, telegraphic engineers, and civil and mechanical engineers, all more or less distinct in their objects, but also more or less merging into one another. Such a sub-division would be at present impossible in our own town; but may we not fairly embrace in our Society of Chemical Industry the consideration of matters chemical, mechanical and physical, whether in a purely scientific way or in their applications, and make the Society for this town at least representative of what we may term the industrial sciences? Surely this blending of aims would be desirable. With regard to the advantages of association, few of us need any information. In one sphere or another we must surely have felt the wholesome emulation and stimulation derived from mingling with those of kindred aims and pursuits, especially when the common aim is that of advancement and improvement. And here let me say a word respecting what, to some, may appear a fatal hindrance to such association amongst those who are engaged in a keen competition and rivalry in their industrial pursuits. It is frequently urged that important trade secrets may be divulged, to the detriment of the individual, and to the advantage of his rival. True science has no secrets; the aim of the scientific man is to learn fresh truth, and to scatter it broadcast. On this side, therefore, you *must* be gainers by association with men of scientific training, thought, and habit. And surely, regarding special unpatented processes, our very interests would for the time keep us silent. There are few of us who have not frequently to harbour a secret; and if we are successful in doing so elsewhere, why not in our Chemical Society? It cannot be maintained that the advances in industrial science are invariably or even mainly for any length of time in this secret state; and if we help to keep each other informed of the open and published advances, and develop by discussion their important bearings, we shall find plenty of most important and useful occupation in our meetings. May we not also look for advantage from the association of teachers with old students, both gaining thereby ideas of the practical and broader application of scientific laws and principles.

The whole Society of Chemical Industry assembles every summer alternately in London and in some important provincial centre of industry. These gatherings serve partly as conferences, but they also enable members to visit important works of various kinds, and of the most approved and modern types. Last year a most important visit was made to the industries of the Tyneside. This year the meeting will be held in London in next July, and will naturally find its quarters in the neighbourhood of the Inven-

tions Exhibition, in which not a few members of the Society are exhibitors. This will doubtless prove an attraction. It is hoped that the members of our local Section may be able to obtain in their own district the practical education given by visiting model industrial works; and an attempt will be made, from time to time, to organise such a system of *field instruction*, as the naturalist would term it. We shall be thankful to receive invitations from the proprietors and managers of large works, and shall quite appreciate their kindness in allowing us to see of their best. And now I have placed before you our ideas regarding the infant, at whose formal christening you are present this evening. If you like his looks, and think he shows promise of developing into a useful member of society, do not stand aloof; but, by constantly showing the interest you have evinced in his cradle days, aid his growth into a strong and useful member of your community, and give those of us who look upon the babe with proud and partial eyes of parents and sponsors, reason to rejoice over his rapid development and useful career.

On the motion of Mr. LEWIS T. WRIGHT, a vote of thanks was passed by acclamation to Professor Clowes for his able address, and to the Chairman and Committee of the College for their courtesy in granting the use of the building.

After the address, Mr. LEWIS T. WRIGHT described in detail the various gas lighting arrangements shown in the laboratory, and exhibited a series of models of gas works and processes. At the same time Mr. A. H. SIMPSON was explaining in another part of the building systems of lighting by electricity, illustrated by various types of dynamos and lamps, both arc and incandescent.

Addresses on Tussur Silk, by Mr. T. WARDLE; on Luminous Paint, by Mr. J. B. COLEMAN; and on Dyeing and Bleaching Processes, by Mr. R. LLOYD WHITELEY, served to complete the interest of a most enjoyable evening.

Bristol and South Wales Section.

Chairman: Prof. W. Ramsay.

Vice-Chairman: P. J. Worsley.

Committee:

H. W. Atkinson.
G. Dobson.
A. C. Fryer.
Thos. Morgans.
A. C. Pass.
F. Payer.

W. Pringle.
Albert E. Reed.
G. S. Schacht.
W. A. Shenstone.
C. M. Thompson.
W. Windus.

Local Secretary and Treasurer:

E. G. Marks, 9, Nelson Street, Bristol.

Journal and Patent Literature.

I—GENERAL PLANT, APPARATUS, AND MACHINERY.

Ebullition of Water considered in regard to Steam Engines. H. Walther-Meunier. Bull. Soc. Ind. Mulhouse, 1885, 113.

THIS is a discussion of evidence from various sources as to the cause of boiler explosions. The ebullition of water, from this point of view, has been investigated by Donny (Ann. Chim. Phys. [3], 16, 177, 1846), Dufour (Archiv. Bibliothèque Univ. 1864, and Pogg. Ann. [5], 4), Kayser (Zeits. Verein. Dent. Ing. 9 and 10), Cohn (*Ibid.* 14), and Gernez (Ann. Chim. Phys. [5], 4). By their experiments two main results are established:—(1) for the production of the phenomenon of the super-

heating of water, the condition of perfect repose of the liquid mass is indispensable; (2) the presence of minute quantities of gases is sufficient to maintain a normal ebullition. These considerations are applied in an exhaustive discussion of the conditions of ebullition in steam generators of the various types now employed, which, the author shows, are such as to practically exclude the possibility of superheating. He maintains, on the other hand, that boiler explosions are referable either to defects in materials or construction, or to want of observation of necessary precautions.—C. F. C.

On the Construction of Boiler Chimneys. P. Huth. Chem. Zeit. 9, 692.

A DISUSED chimney, 20 metres high, 0.5 metre lower, and 0.35 metre upper diameter, was connected with a boiler 8 metres long, 1.6 metre diameter, with an inner flue 0.5 metre diameter, the total length of flue being about 30 metres. The chimney was found inefficient, and a new one was built, the length of flue being 29 metres, and the width at least 0.65 metre square. With the increased dimensions of flue, a chimney 12 metres high was found to be fully equal to the former chimney of 20 metres, and when it reached 16 metres it was again tested and found fully efficient; the smoke being white, free from soot and flue dust, and the heating effect of the boiler excellent. The coal used was also reduced 15 to 20 per cent. The damper was only required to be one-quarter open. The principal factor therefore to be considered is not only the height of a chimney, but also its proportional width. High chimneys are, on the whole, too narrow, and it would be useful to determine the most effective relation of height to width in the construction of chimneys.

—J. B. C.

Improvements in the Process of and Apparatus for Producing Cold. J. H. Johnson, London. From J. C. Rossi, U.S.A. Eng. Pat. 8777, June 10, 1884.

The apparatus consists of a series of two or more concentric annular vessels, provided with stirrers, the outer vessel containing the vessels of water or the liquid to be cooled. Nitrate of ammonium, equal in weight to the water in the vessel, is dissolved in the innermost vessel with agitation. The solution of the salt may be recovered by evaporation. The cold in the liquid finally discharged is recovered by causing it to cool either air or water to be used in the various parts of the machine.

—C. C. H.

An Improved Non-conducting Composition for Protection Against Heat. S. P. Wilding, London. From Würtz & Co., Ludwigshafen, Germany. Eng. Pat. 9063, June 17, 1884.

THE inventors aim at producing a non-conducting composition, the bases of which is granulated cork, in a condition in which it can be painted or coated on to the surfaces it is intended to protect. Such a composition is light, tough, highly elastic, and a very bad conductor of heat. They proceed as follows:—10 parts well-loosened asbestos fibre is mixed in a wet condition with 150 parts fossil meal, to which has been added 3 parts clay and 2 parts solution of soluble glass; the whole is intimately mixed with 150 parts of disintegrated cork. The mixture is dried quickly at a temperature of 100°, and the cakes ground fine. When the composition is used it is mixed with water into a thin paste, and applied to the heated surfaces with a brush. The patentees claim the manufacture of a non-conducting composition substantially as described.—C. C. H.

Apparatus for Drying in Vacuo. H. J. Haddan, London. From E. Pussburg, Moscow. Eng. Pat. 1997, February 12, 1885.

THE apparatus described in this specification is an improvement on that described in a former specification for effecting the same work. The vacuum vessel is a horizontal cylinder, steam-jacketed on the exterior, and also

heated in the interior by an annular cylinder capable of being heated by steam and revolving on trunnions. The exterior of the annular cylinder is provided with arms for the agitation of the material under treatment. The untreated material is fed into one end of the cylinder from a vessel which is isolated by a valve, when necessary, so that the introduction of fresh liquid does not destroy the vacuum. The evaporated material is removed from the other end on the apparatus by a similar appliance, so that the working is continuous and without a break. The whole apparatus and its several details is covered by six different claims.—C. C. H.

II.—FUEL, GAS, AND LIGHT.

Observations upon a Proximate Constituent of Coal. P. F. Reinsch. Dingl. Polyt. J. 256, 224.

IN the course of recent observations upon the microscopic structure of coal, the author found that alkaline solutions dissolved out a certain constituent, leaving a large proportion of insoluble matter morphologically unchanged. The nature of the soluble constituent is now further investigated. By boiling coarsely-powdered coal with strong potash solution, diluting, and allowing to stand at rest for some time, a sediment is deposited, which contains the insoluble constituents, and which is suitable for microscopic examination. The supernatant, opaque, dark brown liquor is passed through a filter, saturated with a dilute acid, and the solution put on one side. After a short time a voluminous jelly-like mass of dark-brown colour will have settled down. The precipitate so obtained shrinks to one-tenth of its original volume when dried, is unaffected by concentrated sulphuric, nitric, and hydrochloric acids in the cold, is attacked by warm nitric acid with evolution of nitrous fumes, dissolves gradually and completely in ammonia solution, burns without swelling up when heated on platinum foil, leaving a slight residue, and evolving a small amount of ammonia. In the ordinary yields of the bituminous coal seams of Saarbeck, Ruhrbeck, Belgium, Silesia, Bohemia, Newcastle, Pittsburg, Indiana, Illinois, in so-called "whitecoal" and Tasmanite, the author has either failed completely to detect this soluble constituent by the above process, or has found it to be present in amounts certainly less than one per cent. In the leaf or paper-coal of the carbon formation of central Russia, this amorphous constituent has up to the present been found to occur most abundantly, several experiments giving 85 to 95 per cent. of insoluble matters, and 15 to 5 per cent. of the amorphous body soluble in alkalis, and precipitated from the alkaline solution by acids. This substance likewise occurs in the bituminous coal from Metschowk, which contains about 10 per cent. of the so-called "soot-coal," and the author considers it probable that it is present in many coals, but in such a form that it cannot be isolated by the action of alkalis alone.

—W. D. B.

The Utilisation of Coke-dust. P. Koehler. Chem. Zeit. 9, 726.

THE dust left in gas retorts after withdrawing the coke, or accumulated at the bottom of long-standing coke heaps, when mixed with one-fourteenth its volume of soft clay, subjected to strong pressure and dried in the air, forms hard blocks of good combustible material, which may be transported without breaking up.—J. B. C.

Improvements in the Manufacture of Gas applicable for Heating Purposes. Michael Cahen, Brussels. Eng. Pat. 11,335, August 15, 1884.

THIS is a process for the production of pure carbonic oxide gas by passing pure carbonic acid gas through coal or other solid fuel in a chamber externally heated. This chamber is built in three parts, the lowest being designed to hold the ashes and scorie, the middle one, wherein the conversion of the carbonic acid mainly takes place, and an extension, as it were, of this above for the introduction of coal, etc., and carrying off of the evolved gases. The middle part, where, of course, the heat is

most intense, is of fire-clay; the other two of cast-iron. When the carbonic acid is conducted into the glowing fuel it is not only converted into carbonic oxide, but it also assists in carrying off the hydrocarbon vapours and ammonia there disengaged. A good deal of the tar deposits on the cool fuel in the higher part of the generator, so that only the more volatile products escape with the carbonic oxide gas. These may be recovered by the usual means, in addition to which a passage through chloride of calcium solution is recommended to remove the ammonium carbonate. The pure carbonic acid used in this process is obtained by the combustion of the heating-gas, by subjecting the gaseous mixture to the pressure of one atmosphere in the presence of water, which under these circumstances absorbs 1.185 times its bulk of carbonic acid, against 0.016 time its bulk of nitrogen. The absorption is effected in a closed water-conduit, so constructed that the stream of water passing through it rises in one place to a height of at least forty feet above the level of the main body of the conduit. This column of water maintains in the horizontal portion of the conduit a minimum pressure of 1 atmosphere. From this elevation the water, having yielded up its carbonic acid, is brought down again, and kept in continuous circulation. It will thus be seen that the water in the lower portion is subject to a sufficient pressure to effect the separation of the carbonic acid and nitrogen. The latter passes away into the air by a pipe leading upwards from the conduit; this pipe, of course, being high enough to allow the required pressure to be maintained in the conduit. Circulation is kept up partly by the injection of the gaseous mixture, which it is desired to separate, and partly by a revolving screw. As the water moves upwards in the raised portion of the conduit it becomes subject to a reduced pressure, and the carbonic acid is disengaged. It is then collected by suitable means, and used as above for the production of carbonic oxide. The inventor gives figures showing by this process a saving of 74 per cent. on coke, and 65 per cent. on coal. Another most important advantage is that sufficient heat is generated by this pure carbonic oxide to enable a hot blast of air to be dispensed with under practically all circumstances.

—A. R. D.

Improvements in the Treatment of Petroleum. L. A. Groth. From Mrs. T. N. Flesch, Annweiler, Germany. Eng. Pat. 12,457, September 16, 1884.

To a litre of petroleum is added 500grm. of green vitriol, and the mixture is boiled for twenty minutes. This takes place at a temperature above 100° C. The liquid is now separated from the hard mass formed during the boiling, and mixed with twice its volume of petroleum. This yields a clear product without smell, which may be burned with safety, and gives a clearer and brighter light than ordinary petroleum.—A. R. D.

Improvements in Fire-lighters. E. G. Brewer. From Camille Navarre, Capelle au Bois, Belgium. Eng. Pat. 15,072, November 15, 1884.

Dry breeze, dry pitch, resin, petroleum, straw, refuse of flax, sawdust, chips of wood and cork, or other easily combustible materials, preferably in the proportion of 71 per cent. of resin, 15 per cent. of petroleum, and 14 per cent. of the other materials, are formed into a paste and moulded into suitable forms. Drawings are given of the shapes preferred. The lighters are bored with one or several holes to produce a current of air, that the combustion may be certain, whether the lighter be or be not covered with coal. For better ignition, wicks of some inflammable substance are provided.—W. D. B.

Improvements in Apparatus for Purifying Coal Gas. A. Dempster, Elland, Yorkshire. Eng. Pat. 2169, February 14, 1885.

A VESSEL of suitable size, shape, and material, standing preferably just after the condenser, is fitted with a pipe which enters at the bottom and extends to the top, its upper end being closed. This pipe has four or more

lateral openings for the passage of the gas. Around the pipe are placed perforated plates, inclined at such an angle that the streams of gas impinge against the edges of the holes, and are roughly broken up. The gas is also washed here by a stream of strong ammoniacal liquor trickling down the inclined plates. Surrounding the inclined plates, and arranged in concentric rings, are a series of vertical plates, perforated with holes increasing in size the nearer they are to the inclined plates. These vertical plates are fastened to the main vessel at the top, and stand on chairs or supports at the bottom, being luted with the strong ammoniacal liquor. After the gas has passed through all the rings of plates, it leaves the chamber by a suitable exit hole. The ammoniacal liquor is fed in by a self-acting distributor.—A. R. D.

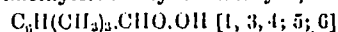
Improvements in Gas Producers. C. D. Abel, London. From F. Siemens, Dresden. Eng. Pat. 9103, March 16, 1885.

THIS invention applies to those gas producers wherein combustible gases are generated by the passage of a limited supply of air through incandescent solid fuel. Ordinarily the hydrocarbon gases evolved are so mixed with carbonic oxide that it is impossible to economically treat the mixture for tar, ammonia, etc. By this invention the gas producer is arranged in compartments which approximately separate the zone where hydrocarbons are evolved from the carbonic oxide zone. The hydrocarbons may thus be drawn away and washed for tar, ammonia, etc., or brought back through the incandescent fuel, or through the outlets for carbonic oxide, and be converted by the heat into permanent gases. Of course, this conversion might be attained by conducting the heavy hydrocarbon vapours through a separate furnace. It is also proposed to arrange the upright air-supply nozzle in a column of brickwork, and to provide it with a cover or plug having openings for the distribution of the air-blast in any desired direction. The specification is accompanied by plans showing how the invention may be applied to the principal forms of producers in common use.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

On Pseudo-cumenol. K. Anwers. Ber. 17, 2976.

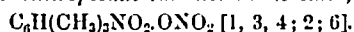
THE compounds described were obtained from pseudo-cumenol $C_9H_7(CH_3)_2.OH$ [1, 3, 4, 6] (Ber. 11, 29 and 17, 2676). Trimethylortho-oxybenzaldehyde,



was prepared, according to Reimer-Tiemann's method (Ber. 9, 824), by dissolving equal weights of ϕ -cumenol and caustic soda in 50 parts of water, and adding gradually one part of chloroform, the mixture being heated on the water bath for three or four hours. The yellow liquid was acidified with hydrochloric acid and hydrolysed. After digesting the distillate for four hours with dilute alkali, a clear brown substance remained, while the filtrate when acidified deposited a yellow precipitate, consisting of a mixture of unaltered phenol and oxyaldehyde. The substances were separated by fractional crystallisation from alcohol, in which the oxyaldehyde is but slightly soluble. The pure substance crystallised in yellow needles, melting at 105-106°. It is insoluble in water, but dissolves easily in ether, chloroform, and glacial acetic acid. It forms a mirror with ammoniacal silver solution. The chloroform reaction gives only ortho and para compounds, and as the latter is impossible in this case, the constitution is proved. The oxyaldehyde exhibits all the properties of an ortho compound. The brown residue insoluble in dilute alkali crystallised readily from alcohol in long lustrous prisms and tables, melting at 98-99°. It is insoluble in cold water, moderately soluble in alcohol ether, chloroform, and acetic acid. Its composition was found to be $C_{10}H_{12}Cl_2O$, but its constitution was not ascertained. The formula $C_9H(CH_3)_3.CHO.OH$ appears unlikely, on account of the great stability of the substance with

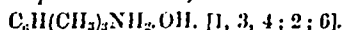
alkalis. It is more probably a dichloromethyl ether of pseudo-cumenol, $C_6H_2(CH_2)_2OCHCl_2$.

Metanonenitropseudo-cumenol nitric ether,



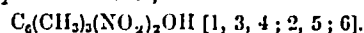
One part of ϕ -cumenol was dissolved in 6 parts of cold fuming nitric acid, and the solution was poured into water. The yellow solid was pressed between filter paper and washed with cold alcohol. It crystallised from ether in lustrous rhombic tables or prisms, melting at 84° with decomposition. The substance was analysed. It is insoluble in water, slightly soluble in cold alcohol, ether, and acetic acid, but readily soluble in chloroform. It forms a red solution, with caustic alkalis, but undergoes decomposition, for on addition of hydrochloric acid a yellow body is precipitated, and nitrous fumes are evolved. The precipitate, however, still contains nitrogen; hence the two nitro groups are differently combined, and probably the hydrogen in the hydroxyl group is replaced by NO_2 .

Meta-amitropseudo-cumenol,



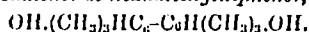
A solution of the nitric ether in glacial acetic acid was reduced with hydrochloric acid and tin, when hydrogen and nitrous fumes were evolved. The tin was precipitated, and the filtrate evaporated, when the hydrochloride of the base separated in yellow-brown crystals. The base was precipitated from a solution of the hydrochloride as a white substance which turned brown in the air. It was found to be identical with Liebermann's oxyeumidine prepared from phenylazo-cumenol (*Ber.* 17, 886). The substance does not form an anhydro-compound, hence the hydroxyl and amido groups are probably in the meta position.

Dinitropseudo-cumenol,



When 5 to 10cc. of concentrated alcoholic ammonia are added to a gram of the nitric ether, the latter is dissolved with evolution of heat, but fine needles are soon deposited. The ammonia was neutralised with hydrochloric acid and the substance crystallised from alcohol. It formed yellow crystals, melting at 110° . It is insoluble in cold water, but dissolves easily in alcohol, ether, chloroform, and acetic acid. It deliquesces when heated above the melting point. It dissolves in aqueous alkalis without change.

Dipseudo-cumenol or hexamethyldiphenol,



In the preparation of pseudo-cumenol a black-brown resin was formed, which was not volatilised by the steam. By treating the resin with alcohol, white crystals were obtained, which, when recrystallised from acetic acid, melted at 172° . The same substance was obtained by Hofmann from the resin formed in the preparation of pseudo-cumenol ether from pseudo-eumidine (*Ber.* 17, 1918). The product dissolves in alkalis without decomposition. The yield was only 2½ per cent. of the ϕ -pseudo-eumidine employed, but Hofmann has obtained a similar compound by treating the tetramethylphenol with potassium bichromate and acetic acid. In the same way the author obtained dipseudo-cumenol by the oxidation of ϕ -cumenol.

Dipseudo-cumenol methylether. The two substances were further identified by introducing methyl groups by means of caustic potash and methyl iodide, but the analyses left it uncertain whether the mono or dimethyl compound was formed.—S. Y.

Separation of so-called α -lutidine. A. Ladenburg and C. F. Roth. *Ber.* 18, 913.

THE authors recently described the separation of a lutidine from commercial picoline; they now announce the isolation of a second lutidine from animal oil, boiling from 160° to 180° , obtained from Kahlbaum. The oil was fractionated into four portions, the lowest boiling between 158° and 160° . From this fraction two lutidines were separated, the first by means of mercuric chloride, the second with ammonium molybdate. The first of

these is described. By the addition of mercuric chloride to a strongly acid solution of the mixed hydrochlorides, a flocculent colourless precipitate was obtained. The substance melted at 125° , dissolved in hot water, and crystallised on cooling in white needles, melting at 130° . The formula was found to be $C_7H_5NHCl.2H_2Cl_2.3H_2O$. The base, liberated by caustic potash, boiled at 157° . It is more soluble in cold than in hot water, and dissolves in all proportions in alcohol and ether. The odour resembles that of fresh-cut cucumber. The formula is C_7H_5N . It is not coloured red either by concentrated hydrochloric acid or by benzoyl chloride. The crystalline platinum and gold salts were prepared and analysed. The oxidation of the lutidine was effected by boiling it with a 3 per cent. solution of potassium permanganate. When the colour disappeared the liquid was allowed to cool, filtered, neutralised with sulphuric acid and evaporated. The potassium sulphate was precipitated by alcohol, and the latter distilled off. The silver salt was prepared, washed with cold water, and decomposed by sulphuretted hydrogen. On evaporation of the filtrate the acid was obtained in lustrous scales, melting at about 235° . The formula was found to be $C_7H_5NO_4.H_2O$. It is, therefore, a pyridine dicarboxylic acid, and it is probably the $\alpha\gamma$ compound, identical with Böttinger's pyridine dicarboxylic acid. Small quantities of impurities alter the physical properties of the acid very greatly, and a second preparation agreed very closely before careful purification with Weidel and Herzig's lutidine acid, which the authors believe to be also identical with theirs. The calcium, copper, lead, barium and silver salts were prepared. On heating the acid slowly to 245° in a current of hydrogen, carbon dioxide and γ -pyridine carboxylic acid were formed. The acid was obtained from the precipitated copper salt. When crystallised from hot water, it melted at 296° , but after sublimation at 303° . It was undoubtedly isonicotinic acid, and hence the lutidine and lutidine acids must be $\alpha\gamma$ compounds. Five pyridine dicarboxylic acids are now known with certainty:—1, quinoline acid ($\alpha\beta$); 2, cinehomeric acid ($\beta\gamma$); 3, α -lutidine acid ($\alpha\gamma$); 4, β -lutidine acid ($\alpha\alpha'$); 5, isocinehomeric acid ($\beta\beta'$ or $\alpha\beta'$). The reduction of the $\alpha\gamma$ lutidine was effected by treating a hot concentrated alcoholic solution with sodium. No smell of ammonia was observed. Water was added, and the base distilled over with steam. The hydrochloride was prepared and purified, and reconverted into the base. The $\alpha\gamma$ hydrolutidine boils at 140° to 142° , and is easily soluble in water, alcohol and ether. Its odour resembles that of the piperidine bases. Its formula was found to be $C_7H_{12}N$. The secondary nature of the base is shown by its compound with carbon-bisulphide and benzoyl chloride. The hydro-chloride melts at 235° , and has the composition $C_7H_{12}N.HCl$. The hydrobromide and picrate were prepared, also the gold and platinum double chlorides. The authors have isolated naphthalene from the animal oil boiling above 170° .—S. Y.

Retene. E. Bamberger and S. C. Hooker. *Ber.* 18, 1024.

CERRAIX facts observed by Ekstrand—viz., the reduction of retistene-quinone to retene by means of zinc dust, and the production of retene from retistene-ketone, have induced the authors to repeat their analysis of the quinone, to which they had previously assigned the formula $C_{18}H_{14}O_2$. The results of the later analysis shows this substance to have the composition $C_{18}H_{16}O_2$, the discrepancy being attributed to its difficultly combustible nature. This compound is, therefore, the quinone of retene, and not of the hypothetical hydrocarbon retistene. It yields, on oxidation with permanganate solution, oxyisopropylidiphenylketonecarboxylic acid, and diphenylketonecarboxylic acid.—J. B. C.

On Nononaphthene. M. Konowalow. *Journ. d. Russ. Phys. Chem. Gesellsch.* 1884 [2].

THIS hydrocarbon $C_{19}H_{18}$ has been separated from the kerosine of the rock oil of Balachany, as well as from Beibatzky's rock oil. It boils at 135° to 136° , and has the specific gravity 0.7808 at 0° and 0.7652 at 20° . It is

acted on energetically by bromine, but only substitution products are formed. The presence of aromatic hydrocarbons could always be detected by Gustavson's reaction, but the amount never exceeded 0.5 per cent. Nononaphthene yields two chlorides of the composition $C_{19}H_{17}Cl$, the one boiling at 185° to 188° , the other at 182° to 184° . The latter compound, when heated in a tube with silver acetate, yielded an ether which boiled at 200° to 203° , and possessed a pleasant fruity smell. By heating the higher boiling chloride with plumbic hydrate, an alcohol was formed which yielded a ketone on oxidation, and, when heated in a tube with calcium iodide, it gave an iodide $C_{19}H_{17}I$, which distilled between 100° and 110° , at a pressure of 24 mm., and was converted into an alcohol when treated with silver oxide. The chlorides in all the reactions described, yielded as a bye-product a nononaphthylene $C_{19}H_{16}$, hydrochloric acid being liberated. This hydrocarbon boiled at 135° to 137° , and its specific gravity was found to be 0.8068 at 0° . By oxidation with chromic acid, nononaphthylene yielded ethylmethylketone, and a number of acids containing 2, 3 and 4 atoms of carbon. Nononaphthylene is reconverted into nononaphthene by heating it with hydriodic acid in closed tubes to 150° to 200° , and finally to 250° .—S. Y.

On a Homologue of Quinoline. C. Beyer. Journ. f. Pr. Chem. 31, 47.

ANILINE was heated in closed tubes with acetone, nitrobenzene and hydrochloric acid, when an oily base, of the composition $C_{11}H_{11}N$, volatile with steam, was obtained. The hydrochloride and sulphate are easily soluble. The platinum double salt forms flesh-coloured needles, melting at 227° . The picrate crystallises from acetone in lustrous yellow scales, melting at 170° ; the chromate separates from water in yellow-red needles, which are more freely soluble than the chromates of other quinoline derivatives.—S. Y.

IV.—COLOURING MATTERS AND DYES.

Compounds of Benzaldehyde with Aniline-hydrochloride and Stannic Chloride. A. Elbers. Annalen, 227, 357.

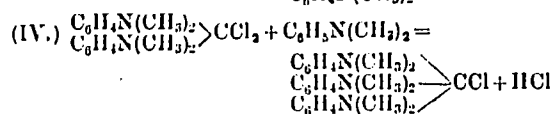
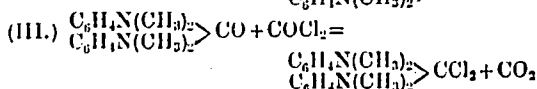
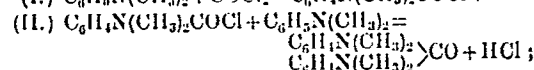
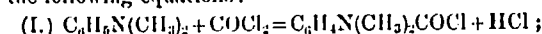
ON adding benzaldehyde to a solution of aniline in strong hydrochloric acid, a precipitate is formed, which, on warming, redissolves, and crystallises out in the form of fine yellow needles. The compound consists of equal molecules of benzaldehyde and aniline hydrochloride, into which it is resolved by water, and is only stable in presence of strong hydrochloric acid. If stannic chloride is also present, a compound is formed, containing benzaldehyde, aniline and $SnCl_4$, in the molecular proportion 3 : 2 : 1.—A. G. G.

A New Synthesis of Pararosaniline. J. Zimmermann and Albert Müller. Ber. 17, 2936.

A MIXTURE of 20 gm. paranitrobenzylidene bromide, prepared as described by Wachendorff by the action of bromine on paranitrotoluene (Ann. 185, 267), with 25 grms. aniline, was heated slowly in an oil bath. The bromide first of all dissolved, then a separation of lustrous scales occurred, probably of the anilide of the para-nitrobenzylidene compound; at 145° a sudden and energetic reaction took place, the thermometer rising to 200° . The excess of aniline was then distilled over with steam, and the residue boiled repeatedly with water. The red aqueous solution imparted to wool and silk a beautiful carmine colour. The solution was precipitated by ammonia or caustic soda, and the colourless precipitate reduced with zinc dust and hydrochloric acid. It was identified as paraleucaniline. The residue, insoluble in water, dissolved easily in alcohol, and gave a bluer colour than the pararosaniline. The reaction differs from that described in a patent by Meister, Lucius and Brüning, inasmuch as a solvent is not employed. The authors attempted to prepare paranitrobenzylidene chloride by the action of chlorine at 130° to 160° on paranitrotoluene, but found that paranitrobenzoic acid was chiefly formed. The action of fuming nitric acid on benzylidichloride also gave negative results.—S. Y.

On Crystallised Methyl-violet. A. W. Hofmann. Ber. 18, 767.

THE author has examined some samples of a new methyl-violet, which has recently been introduced by the Aetienengesellschaft für Anilin Fabrikation, of Berlin. This colouring matter is obtained by the action of chlorinated methyl-formiate upon dimethylaniline in the presence of aluminium chloride. (See this Journal, iv. [4], 279). In its tendency to crystallise well, it surpasses all aniline colours known. The crystals are opaque and show a peculiar greenish-brown metallic lustre. They are readily soluble in water and alcohol, the former solvent being the more suitable one for the purpose of recrystallisation. Many of the crystals were as much as 3 to 4 millimetres in diameter, and so well developed that pretty accurate measurements of the angles could be taken. The crystalline forms were those of the hexagonal prism and pyramid. The analysis of the recrystallised substance gave numbers showing its composition to be that of the hydrochloride of a hexamethylated rosaniline, $C_{19}H_{12}(CH_3)_6N_3Cl$. The composition of the platinum chloride double salt (obtained as a brick-red precipitate by adding platinum chloride to a solution of the colouring matter in concentrated hydrochloric acid) was found to agree with the formula $[C_{19}H_{12}(CH_3)_6N_3Cl_2]_2(PtCl_6)_2$. The leuco compound was prepared by heating the violet with an aqueous solution of ammonium sulphide in a closed tube to 120° , and recrystallising the product obtained from alcohol. It melts at 173° , this being the same melting point as that found by O. Fischer for the base prepared from ordinary methyl-violet, considered by him to be a salt of hexamethylpararosaniline. The mode of preparation and the properties of the crystallised violet bear a great resemblance to those of a likewise well-crystallised violet-colouring matter, which is being manufactured by the Badische Anilin- und Soda-Fabrik. Their patented method (this Journal, iv. [4], 279) is founded on Michler's researches on the action of carbonyl-chloride upon dimethylaniline. The identity of the two colouring matters is therefore highly probable, and was proved by the fact that the leuco base of the latter also melts at 173° . The reactions which take place in the formation of methyl-violet from dimethylaniline and carbonyl-chloride are expressed by the following equations:—



The observation of O. Fischer and G. Körner, that by the action of ortho-formic ether upon dimethylaniline in the presence of zinc chloride a leuco base is formed possessing the same properties and the same melting point as that mentioned, is a further proof for the correctness of the supposition that the colouring matter is a hexamethylpararosaniline. The methyl-violet obtained by Wiechelhaus's method—treatment of dimethylaniline with chloranil—seems also to be a hexamethylpararosaniline, but the author thinks that further experiments are necessary to remove all doubts as to its composition.—F. M.

On the Action of Diazo-compounds on β -Naphthylamine. T. A. Lawson. Ber. 18, 796.

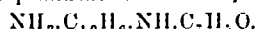
THE researches of Zincke and Bindewald on the hydrazine derivatives of α - and β -naphthoquinones have shown that while the derivative of α -naphthoquinone is identical with the phenyl azo- α -naphthol obtained by the action of diazo-benzene chloride on α -naphthol, the corresponding derivative of β -naphthol is not identical with the

hydrazide from β -naphthoquinone, but is probably an isomeric hydrazine compound.

It appeared likely that a similar difference would be observed in the action of α - and β -naphthylamine on diazo-compounds. The action of diazo-compounds on α -naphthylamine has been frequently studied, and there is no doubt that true azo-compounds are formed. Griess and Meldola have also investigated the action of certain diazo-compounds on β -naphthylamine, but the nature of the products is not so certain. The researches of the author point to the fact that diazo-amido-compounds are formed by the action of diazo-compounds on β -naphthylamine. By boiling the products with acids nitrogen is evolved, and β -naphthylamine reproduced. This is the case with the compounds prepared by Griess and Meldola. These bodies are characterised by their yielding acetyl- and benzoyl-compounds, and on reduction they behave like amido-azo-compounds, yielding a naphthylenediamine.

Phenyldiazo- β -naphthylamine $C_{10}H_7NHN=N-C_6H_5$ was prepared by dissolving 20grm. crystallised diazo-benzene sulphate in 50cc. water and 50cc. alcohol, and adding an alcoholic solution of 14grm. β -naphthylamine. The red precipitate was recrystallised from alcohol. It melted at 102° to 104° . It was not decomposed by boiling with alcoholic potash, or by solution in strong sulphuric acid. This solution has a fine blue colour; hydrochloric and acetic acids also give coloured solutions. When boiled with twenty per cent. sulphuric acid the substance is dissolved with evolution of nitrogen and formation of phenol and β -naphthylamine. The acetyl-compound $C_{10}H_7N(C_2H_5O)N=NC_6H_5$ melts at 152° to 153° , and is very stable. The benzoyl-compound melts at 162° to 163° . These bodies were analysed.

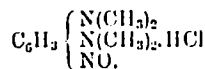
The reduction of phenyldiazo- β -naphthylamine was effected by boiling its alcoholic solution with stannous chloride until the colour disappeared, or by treating it with zinc dust and acetic acid. The base was set free from the hydrochloride or sulphate by addition of sodium carbonate. It melts at 94° , and is easily oxidised. The base has been described by Griess. It is probably an α - β -compound. The hydrochloride and sulphate were prepared and analysed; the composition of these salts is $C_{10}H_7(NH_2)_2 \cdot 2HCl$, and $C_{10}H_7(NH_2)_2 \cdot H_2SO_4$. The picrate was also prepared. The acetyl-compound melts at 234° , and has the composition $C_{10}H_7(NHC_2H_5O)_2$. The benzoyl-compound melts above 280° , and its formula is



—S. Y.

On Nitroso-derivatives of Aromatic Diamines. O. N. Witt. Ber. 18, 877.

THIS paper contains some preliminary communications on the nitroso-amines corresponding to the nitroso-resorcin. By adding to a cold solution of tetramethylmetaphenylenediamine in an excess of dilute hydrochloric acid, a moderately dilute solution of sodium nitrite, a deep reddish-brown precipitate is formed, which by recrystallisation from slightly acidulated hot water is obtained in a state of purity. It then forms deep garnet-red, almost black, lustrous needles, which in pure water dissolve with a claret-red colour. The analysis showed this body to be the monohydrochlorate of a mononitrosotetramethylmetaphenylenediamine,

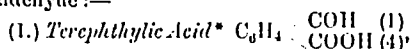


The free nitroso-base is prepared by adding sodium carbonate or hydrate to an aqueous solution of this body, and extracting the now orange-yellow solution with ether. On the evaporation of the ether the base is left as a deep-brown, oily liquid, which gradually assumes a crystalline form. The aqueous solution of the nitrate of this base gradually decomposes, a reddish-yellow precipitate, probably consisting of nitrotetramethylphenylenediamine, being formed. Reducing agents quickly decolorise the solutions. The new nitroso-compound readily combines with amines and phenols to form colouring matters of different shades. Those

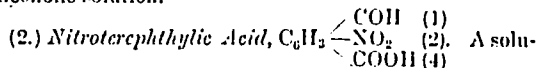
derived from naphthylamine, naphthol, and resorcin exhibit a strong fluorescence. The red salt described was likewise obtained by acting with two molecules of sodium nitrite upon one molecule of the diamine, no dinitroso-compound being formed in this case. The nitroso-group diminishes the basic properties of the diamine; the latter forms stable salts with two molecules of hydrochloric acid, whereas the nitroso-compound combines with only one molecule. Tetramethyltoluylenediamine behaves in a similar manner to the phenylene-compound, but the nitroso-compound could not be separated in solid form.—F. M.

On Indigodicarboxylic Acid. Wilhelm Löw. Ber. 18, 917.

THE material from which the indigo-dicarboxylic acid was prepared was terephthalaldehyde, which was obtained from paraxylylene bromide (prepared by brominating paraxylylene) by boiling it with water. The author describes the following derivatives of terephthalaldehyde:—



obtained by oxidising the aldehyde with the calculated quantity of potassium bichromate and sulphuric acid. It crystallises in needles, melting at 255° . The ether was prepared by passing hydrochloric acid gas into the alcoholic solution.



tion of terephthyllic acid in concentrated sulphuric acid was treated with the calculated quantity of potassium nitrate dissolved in sulphuric acid. The nitro-acid forms large needle-shaped prisms, melting at 160° . It gives the indigo reaction with acetone. The ethyl ether is an oil.

(3.) *Paracarboxyleinnamic Acid,*

$C_6H_4 \begin{Bmatrix} CH \cdot CH \cdot COOH \\ COOH \end{Bmatrix} (1)$ This was best obtained by heating terephthyllic ether with sodium acetate and acetic anhydride, and boiling the product with dilute caustic soda. The acid cannot be fused, and is almost insoluble in most substances. It may be crystallised from hot glacial acetic acid.

(4.) *Paracalibromocarboxyleinnamic Acid,*

$C_6H_4 \begin{Bmatrix} CHBr \cdot CHBr \cdot COOH \\ COOH \end{Bmatrix}$, was prepared by the direct action of bromine, at 100° , on the last compound. It was crystallised from methyl-alcohol.

(5.) *Nitrocarboxyleinnamic Acid,*

$C_6H_3 \begin{Bmatrix} CH \cdot CH \cdot COOH \\ NO_2 \\ COOH \end{Bmatrix} (1)$ (2), was formed by treating the

carboxyleinnamic acid with a mixture of nitric and sulphuric acids. It crystallises from hot water in needles, which melt at 287° , but decompose partially.

(6.) *Dibromonitrocarboxyleinnamic Acid,*

$C_6H_3 \begin{Bmatrix} CHBr \cdot CHBr \cdot COOH \\ NO_2 \\ COOH \end{Bmatrix} (1)$ (2), obtained by the

direct action of bromine, at 100° , on the nitro-acid, yields, when treated with concentrated caustic soda, the corresponding propiolic acid, $C_6H_3 \begin{Bmatrix} C \cdot C \cdot COOH \\ NO_2 \\ COOH \end{Bmatrix}$, nitro-phenylpropionic acid.

Indigodicarboxylic Acid.

(1.) Nitroterephthyllic acid was treated with acetone and caustic soda, and the very dilute solution was heated for two hours to 50° . By the addition of dilute sulphuric

* Note by Abstractor.—I have ventured to call this acid "terephthyllic acid," because it stands between terephthalaldehyde and terephthalic acid, just as glyoxylic acid occupies a position between glyoxal and oxalic acid.—S. Y.

acid to the dark green solution, a deep blue precipitate of indigodicarboxylic acid was obtained. After washing and drying, it exhibited a coppery lustre.

(2.) A very dilute solution of nitrophenylpropionic acid in sodium carbonate was heated with grape sugar and caustic soda until permanently alkaline. The indigo-compound was separated from the green solution as before. Indigodicarboxylic acid is insoluble in ether, chloroform, and alcohol, but forms a deep blue solution with sulphuric acid, from which water precipitates the acid unaltered. The spectrum of the solution in alkalis resembles that of indigo, but the bands are nearer the red. The metallic salts are generally green or blue, but the silver salt has a sepia-brown colour. The barium salt has the composition $C_{18}H_{12}N_2O_6Ba$, but the silver salt contains four atoms of silver, so that the hydrogen atoms of the imido groups must also be replaced.

The ethyl ether was prepared from the nitro-terephthyllic ether by the first method described above. It melts at a high temperature, and sublimes in prismatic crystals. It dissolves with a deep blue colour in sulphuric acid, and is reprecipitated by water, but undergoes partial saponification.—S. Y.

A New Group of Colouring Matters. O. N. Witt. Ber. 18, 1119.

THESE bodies are obtained by heating the amidoazo derivatives of *p*-toluidine (m.p. 118.5) with the hydrochlorides of primary amines. With α -naphthylamine, a product is obtained which bears no analogy to the indulines. The following is the method of preparation: 13grm. amidoazo-toluene are mixed with 18grm. α -naphthylamine hydrochloride, and as solvent 50grm. to 60grm. free naphthylamine are added. The mixture is warmed on the water-bath until the green colour changes to an orange-red. The calculated quantity of NaOH required to saturate the HCl present is added, and 3 to 4 volumes of alcohol. The new compound separates out on cooling. Crystallised from aniline, it forms yellow needles, having the formula $C_{21}H_{18}N_4$. The hydrochloride and sulphate of the base dissolve in water with a scarlet colour, and dye cloth the same shade. On soaping, the colour changes to yellow. Fuming sulphuric acid converts it into a sulphonated compound. The sulpho salt colours silk, in acetic acid solution, a fine orange. From the analysis, it appears probable that the substance is a safranin derivative of *o*-toluylenediamine. The above reaction is not limited to amidoazotoluene, but is common to all amidoazo bodies which contain the amido group in the ortho position with respect to the nitrogen atom. The azo derivatives of β -naphthylamine, as also the chrysoidines, give the same reaction. This reaction may be therefore used in determining the relative positions of the substituted groups in amidoazo compounds.—J. B. C.

β -Sulphophthalic Acid. C. Graebe. Ber. 18, 1126.

BINITRONAPHTHOL-SULPHONIC acid (the free acid of the potash salt, which forms the naphthol yellow S of commerce), when heated on the water-bath with nitric acid of sp. gr. 1.3, yields β -sulphophthalic acid. It is obtained as a syrup, which crystallises with difficulty, and is easily soluble in water and alcohol, but not in ether. The crystallised substance contains 1mol. of water. Sulphophthalic acid gives a corresponding fluorescein derivative, which has no technical value as a colouring matter. It may be converted into β -oxyphthalic acid and the corresponding cosines.—J. B. C.

Intermediate Products of Reduction of the Nitroazo Compounds. J. V. Janovsky and L. Erb. Ber. 18, 1133.

THE paper is to a certain extent a repetition of the researches of Gerhardt, Laurent and Petrieu on the nitro derivatives of azobenzene. The authors have prepared the mono and the dinitro derivatives, the former yielding, on reduction, aniline and *p*-phenylenediamine, and the latter *p*-phenylenediamine, thus proving that the nitro groups occupy in reference to the azo group the posi-

tion 1.4. In the preparation of these nitro compounds, in addition to the above crystalline products, a considerable quantity of a red oil is formed. This, on reduction, yields *m*-phenylenediamine, and the oil is therefore a *m*-dinitroazobenzene. By further nitrating the dinitro compound, two trinitroazobenzenes are formed. By reducing mononitroazobenzene with $(NH_4)_2S$, azoamidobenzene is obtained. From the dinitro compound, hydrazodinitrobenzene and hydrazoamidobenzene are produced. On the other hand, if an alkaline reducing agent, such as an aqueous solution of $(NH_4)_2S$, or alkaline solutions of $ZnCl_2$, $SnCl_2$, or grape sugar, all the nitroazobenzenes yield intermediate products, which the authors have named "nitrolic acids" of azobenzene. The constitution of these bodies is explained by the following formulae:—

Nitrolic acid from mono- $\left\{ \begin{array}{l} C_6H_5-N=N-C_6H_4.N.OH \\ \text{nitroazobenzene} \dots\dots\dots C_6H_5-N=N-C_6H_4.N.OH \end{array} \right.$

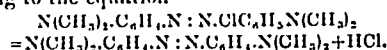
Nitronitrolic acid from $\left\{ \begin{array}{l} NO_2C_6H_4-N=N-C_6H_4.N.OH \\ \text{dinitroazobenzene} \dots\dots\dots NO_2C_6H_4-N=N-C_6H_4.N.OH \end{array} \right.$
—J. B. C.

Brasilin. K. Buehka and A. Erek. Ber. 18, 1138.

BRASILIN gives, on heating with acetic anhydride to 130°, a tetraacetyl and a triacetyl derivative. By the action of bromine on the former compound, a mono-, a tri- and a tetrabromobrasilin were obtained. By the oxidation of brasilin with nitric acid, in an ethereal solution, brasilein, $C_{16}H_{10}O_6$, is formed.—J. B. C.

Azylines. E. Noelting. Ber. 18, 1143.

THE compounds obtained by Lippmann and Fleissner, by the action of NO gas on tertiary amines, were regarded as the azo derivatives of these bases. This view has been confirmed by the author, who, by the action of dimethylaniline upon the chloride of the diazo derivative of *p*-amido dimethylaniline, obtained a substance having the properties of Lippmann's tetramethylazylidine, according to the equation



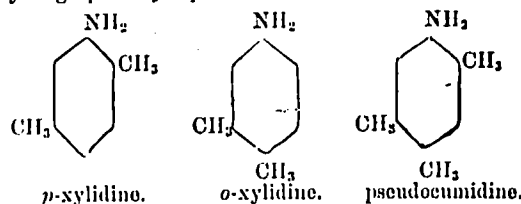
The same compound has been further obtained by the action of methyl-iodide on the base



first prepared by Meldola. The azylines are isomeric with the chrysoidines, and are similarly prepared. The primary substance of this class is the symmetrical diazidoazobenzene, which may be termed "azyline." Like the chrysoidines, these bodies have colouring properties, but owing to the costly process of preparation will probably have no technical value.—J. B. C.

Derivatives of Pseudocumidine. E. Noelting and T. Baumann. Ber. 18, 1145.

THE authors have fixed the constitution of this substance by preparing it from *p*- and *o*-xylylene by heating the hydrochlorides of these bases with methyl-alcohol in sealed tubes. The constitution of these substances may be graphically represented as follows:—



Diazoamidocumene is prepared in the usual way by the action of $NaNO_2$ upon the hydrochloride of cumidine. The diazo compound is then brought into an acetic acid solution of cumidine, and sodium acetate added. Diazoamidocumene separates out. By heating this compound with cumidine and cumidine hydro-

chloride to 60° to 80° it is converted into amidonzo-cumene, which crystallises from alcohol in yellow plates. By reduction with SnCl_2 and HCl , amidoazocumene splits up into cumidine and cumylenediamine, which may be separated by fractional distillation with steam.

Amidotetramethylbenzene.—If cumidine hydrochloride be heated with one molecule of methylalcohol to 200° for ten hours, and then to 300° for a further ten hours, a liquid base is obtained, boiling at 250° C., which crystallises in a freezing mixture. Mesidine, under similar conditions, gives the same compound. It must therefore be a derivative of isodurene, and has received the name of isoduridine.—J. B. C.

Quinones from Para-methylated Amines. E. Noeltling and T. Baumann. Ber. 18, 1150.

THE following amines were oxidised with chromic acid:—*p*-toluidine, *a*-*m*-xylylidine and *o*-xylylidine, the former yielding quinone, the two latter toluquinone in very small quantity. Mesidine gives a satisfactory yield of *m*-xyloquinone (m.p. 72° to 73°) and pseudocumidine, *p*-xyloquinone (m.p. 123°); isoduridine gives on oxidation an oil, which may be purified by first reducing to the crystalline cumolhydroquinone, which, on oxidation, forms the pure quinone (m.p. 11°).—J. B. C.

The Influence of Light on the Course of the Chemical Reaction of Halogens on Aromatic Compounds. I. Schramm. Ber. 18, 1272.

BROMINE when present in excess acts on ethylbenzene in the dark, forming ortho- and paraethylmonobromobenzene. The action of bromine on propylbenzene in the dark is similar, two isomeric bromine derivatives being formed. In the direct light of the sun, however, bromine enters the propyl-radical, forming monobromopropylbenzene in the first instance, and further on, dibromopropylbenzene—e.g., ethylphenyldibromoketole $\text{C}_6\text{H}_5-\text{CBr}_2-\text{CH}_2-\text{CH}_3$. If 1 mol. bromine acts in the dark on monobromopropylbenzene, produced under the influence of sun-light, bromoallylbenzene $\text{C}_6\text{H}_5-\text{CHBr}-\text{CH}=\text{CH}_2$ is formed identical with that made directly from bromine and propylbenzene. Butylbenzene acts exactly like propylbenzene. Paraxylene and bromine form in the dark parabromoxylene, whereas in the presence of light the methyl-radical is attacked. The two isomeric compounds, meta- and orthoxylene, behave like the para compound.—S. H.

Laboratory Notes. E. Noeltling. Bull. Soc. Ind. Mulhouse, 1885, 144.

(a) *New Azo Derivatives* (Sealed Note, June 1, 1881).—Thioaniline ($\text{C}_6\text{H}_4\text{NH}_2\text{S}$) is converted by nitrous acid into a diazo derivative, described some years since by Kraft. This compound treated, on the other hand, with phenols or their sulphonated derivatives, in alkaline solution, yields azo derivatives constituting a class of colouring matters. When aniline is treated with β -naphtholdisulphonic acid, an orange-coloured body is produced; thioaniline under the same treatment yields a ponceau, equal in depth of blue to the ponceau R R of Meister, Lucius and Brünig. Diamidosulphobenzide under these conditions yields an orange; benzidine, on the other hand, a brownish violet, analogous to the Bordeaux of the same makers.

The constitution of these bodies is as follows:—

$\text{C}_6\text{H}_4\text{N}=\text{N}-\beta\text{C}_{10}\text{H}_7\text{OH}(\text{SO}_2\text{H})_2$ orange (M., L. & B.)
 $\text{SO}_2[\text{C}_6\text{H}_4\text{N}=\text{N}-\beta\text{C}_{10}\text{H}_7\text{OH}(\text{SO}_2\text{H})_2]$ orange (Noeltling)
 $\text{S}[\text{C}_6\text{H}_4\text{N}=\text{N}\beta\text{C}_{10}\text{H}_7\text{OH}(\text{SO}_2\text{H})_2]_2$ ponceau (Noeltling)
 $\text{C}_6\text{H}_4\text{N}=\text{N}-\beta\text{C}_{10}\text{H}_7\text{OH}(\text{SO}_2\text{H})_2$ } violet (Bordaux)
 $\text{C}_6\text{H}_4\text{N}=\text{N}-\beta\text{C}_{10}\text{H}_7\text{OH}(\text{SO}_2\text{H})_2$ } (Noeltling)

The bisulphonated derivative of benzidine gives with β -naphthol a beautiful ponceau. The chief interest of these compounds is in showing the influence exerted by the various S-groups in modifying colour.

(b) *Violet Colouring Matter from Paramidophenol* (Sealed Note, June 1, 1881).—Some time since Lauth obtained a series of violet colouring matters by treating the paradiamines of benzene and toluene with hydrogen sulphide and ferric chloride. Corresponding blue derivatives, in which two atoms of H are replaced by alkyl-radicals, have also been obtained. The author finds that paramidophenol is converted by the same treatment into a violet colouring matter. The result is probably typical.

(c) *Isobutyl Anilines* (Sealed Note, June 1, 1881).—By the action of isobutyl bromide upon aniline at 100°, or of isobutyl alcohol upon the hydrochlorate at 200°, mono- or di-isobutyl aniline is formed according to the proportions of the reagent employed. The mono derivative boils at 230-235°. Its acetyl derivative $\text{C}_6\text{H}_4\text{N}(\text{C}_4\text{H}_9)\text{C}_2\text{H}_3\text{O}$ is an uncrystallisable oil, boiling at 260-265°. The latter yields a crystalline nitro derivative, which is converted by the action of tin and hydrochloric acid into monobutylparaphenylenediamine—i.e., with elimination of the acetyl group. This base, treated with hydrogen sulphide, and afterwards with ferric chloride, is converted into a blue colouring matter, soluble in water.—C. F. C.

Pyridine Dicarboxic Acid. E. Noeltling and A. Collin. Bull. Soc. Ind. Mulhouse, 1885, 147.

THIS acid, which is formed by the oxidation of quinoline with potassium permanganate, having its COOH groups in the ortho position, may be regarded as phthalic acid, in which an N atom takes the place of one of the CH groups of the benzene ring. In confirmation of this view the authors have demonstrated the following points of analogy in the reaction of the two acids. They both combine with phenols; heated with phenol and sulphuric acid at 120°, pyridine dicarboxic acid yields a product of condensation which dissolves in alkalis to a red solution. Heated with resorcin and a dehydrating agent at 200°, it yields a derivative resembling fluorescein, this yielding a bromo derivative, having the properties of eosine. In this reaction, however, a considerable proportion of the acid undergoes resolution into carbonic and nicotinic acids.—C. F. C.

Preparation of Blues from Rosaniline. E. Noeltling and A. Collin. Bull. Soc. Ind. Mulhouse, 1885, 148.

ON heating metatoluidine (50pts.) with rosaniline (10pts.) and benzoic acid (5pts.), at 180°, a blue colouring matter is produced, as in the case of ortho- and paratoluidine. α -naphthylamine, under similar conditions, yields a violet, β -naphthylamine a blue (cf. Meldola, Ber. 16, 964). In the preparation of colouring matters of this class, on the large scale, aniline is used as the solvent, the excess being subsequently recovered. The authors have endeavoured to find a more economical substitute for the latter. In presence of phenol the desired result was not obtained; but by using naphthalene the development of a blue from aniline and rosaniline was found to follow the normal course. Experiments on the large scale, however, failed to establish any commercial advantage in the substitution of the hydrocarbon.—C. F. C.

Transformation of Primary Amines into Mononitrophenols. E. Noeltling and E. Wild. Bull. Soc. Ind. Mulhouse, 1885, 153.

DINITRO derivatives of the phenols are formed, as was shown by Griess, when diazo compounds are boiled with nitric acid. By suitably varying the conditions from those which lead to this result, the authors have succeeded in preparing mononitro derivatives.

Mononitrophenol is obtained by operating in the following way:—93grm. aniline dissolved in 200grm. sulphuric acid, at 66° B., previously diluted with 2000cc. water, are diazotised at 0°, with 69grm. sodium nitrite. A quantity of nitric acid (1335 sp. gr.), containing 63grm. HNO_3 , is then added, and the whole is boiled in connection with a reversed condenser, until the disengagement of nitrogen has ceased. The yield, in one experiment, was 20grm. ortho- and 15grm. paranitro-

phenol. The meta compound did not appear to be formed.

Nitroeresylol.—With 107 grm. paratoluidine replacing the aniline in the above, a very considerable yield of the metanitroparacresylol is obtained. In one experiment it amounted to 75 grm., $C_6H_3(OH)(NO_2)CH_3$ —melting at 33.5° . This was the sole product with exception of a small quantity of binitroeresylol and tarry derivatives. From orthotoluidine the nitro-ortho derivative (m.p. 69.5°) was obtained. The yield, however, was less than in the case of the former.

α -Naphthylamine was converted into the nitronaphthol $C_{10}H_7(OH)(NO_2)$ —m.p. 164° —but the yield was small. Further investigations of the influence exerted by varying the conditions of these decompositions, will probably lead to their more complete realisation.—C. F. C.

Nitration under varying Conditions. E. Noelting and A. Collin. Bull. Soc. Ind. Mulhouse, 1885, 163.

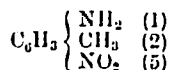
As a contribution to this subject, the authors give the results of nitrating various compounds in presence of sulphuric acid in large excess.

Acetanilide.—The para derivative is easily prepared by slowly adding 590 parts HNO_3 to 1000 parts acetanilide dissolved in 4000 parts H_2SO_4 . The whole is cooled with a freezing mixture. The nitro compound is precipitated on pouring into water, and is obtained pure (m.p. 207°) by once recrystallising. The yield is 95 per cent. of the theoretical. The ortho and meta derivatives are formed only in small quantity; the proportion of the latter is increased by increasing that of the sulphuric acid.

Paratoluidine, nitrated in presence of ten parts of H_2SO_4 , yields a mixture of the isomerides NH_2 , NO_2 , CH_3 (m.p. 114°) and 1, 3, 4 (m.p. 78°); by increasing the proportion of H_2SO_4 to fifteen to twenty parts, the latter only is formed. From 100 grm. of the base, 100 grm. of the nitrotoluidine were obtained.

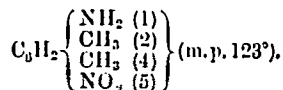
Paracetotoluidine, nitrated in presence of four parts H_2SO_4 , yields, after saponification of the product, the isomeride NH_2 , NO_2 , CH_3 in presence of ten parts H_2SO_4 , a product is obtained, yielding, on saponification, a mixture of the isomeric nitrotoluidines 1, 2, 4 (m.p. 114°), and 1, 3, 4 (m.p. 78°). The proportion of the latter is increased by increasing that of the sulphuric acid.

Orthotoluidine, nitrated in presence of ten parts H_2SO_4 , yields a new isomeride, melting at 107° , and for which the authors have established the formula



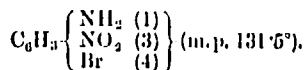
Orthoacetotoluidine yields a mixture of derivatives; but the nitration is, in this case, not so advantageous, and the authors, therefore, recommend the ordinary method.

Meta-xylylene, nitrated in presence of ten parts H_2SO_4 , yields the derivative



Meta-cto-xylylene, nitrated as above, yields, by saponification, the same nitroxylylene (m.p. 123°).

Parabromaniline, nitrated in presence of ten parts H_2SO_4 , yields a new nitrobromaniline



The proof of its constitution is afforded by its yielding, on bromination, in glacial acetic acid, the same tribromonitraniline (m.p. 102.5°), as is obtained from meta-nitraniline.

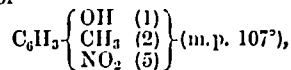
Ethylacetanilide is easily nitrated in presence of five parts H_2SO_4 . On saponifying the product (m.p. 118°),

nitroethylaniline (m.p. 96°) is obtained. This compound is converted, by reduction with tin and hydrochloric acid, into a monoethylphenylenediamine. The reactions of this derivative are those characteristic of the para-diamines.

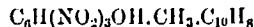
Dimethylaniline, in presence of a large excess of sulphuric acid, yields paranitrodimethylaniline exclusively.—C. F. C.

Nitro-orthotoluidine (m.p. 107°) and some of its Derivatives. E. Noelting and A. Collin. Bull. Soc. Ind. Mulhouse, 1885, 193.

This compound, obtained as described in preceding abstract, crystallises in large prisms. It is soluble in alcohol, ether and acetone, but slightly in water. By diazotising and boiling the product it is converted into nitro-orthoeresol



the yield being nearly theoretical. This compound, treated with bromine in presence of water, is converted into the dibromo derivative (m.p. 91°). By reduction with tin and hydrochloric acid, it is converted into the amido-eresylol (m.p. 160°) obtained by Wallach (Berl. Ber. 15, 2831) from metatoluylenediamine. By diazotising the nitratoluidine dissolves in nitric acid (2 mol.); pouring the product into nitric acid, of sp. gr. 1.33, and boiling, a trinitro-orthoeresol (m.p. 102°) is formed. This compound forms molecular compounds with hydrocarbons; thus with naphthalene the compound

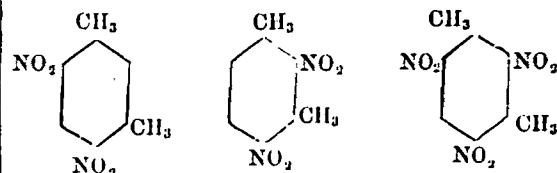


crystallising in yellow needles (m.p. 106°).

Colouring Matters obtained from Metamidoeresol.—Metamidoeresol resembles in its reactions metatoluylenediamine and phenylenediamine. With nitrous acid it gives derivatives of the class of Bismarck browns, and with diazo compounds, chrysoidines. These latter, containing an amido group, may be further diazotised and combined with phenols, oxyacids, etc. On oxidising metamidoeresylol, together with paraphenylenediamine or its homologues, a new series of neutral colouring matters is obtained; analogous compounds may be prepared directly by heating amidoeresol with nitroso-dimethylaniline. These will be described in a further communication.—C. F. C.

Nitro and Amido Derivatives of Meta-xylylene. E. Grevingk. Bull. Soc. Ind. Mulhouse, 1885, 233.

METAXYLENE, nitrated in the ordinary way, is converted into a dinitroxylylene (m.p. 93°); by nitrating in presence of sulphuric acid seven parts, a second isomeride (m.p. 82°) is formed simultaneously, in the proportion of about 25 per cent. of the mixed product. Both isomerides yield the same trinitroxylylene (m.p. 176°) on further nitration. From these and other facts subsequently detailed, the authors deduce the following constitutional formulae:—



Dinitroxylylene (m.p. 93°) Dinitroxylylene (m.p. 82°) Trinitroxylylene (m.p. 177°)

The isomeric dinitroxylenes are difficult of separation; but the corresponding nitroxylylenes, into which they are converted by the action of ammonium sulphide, are sufficiently divergent in physical properties to be easily separable. That obtained from the second isomeride (m.p. 82°) is soluble in water and in petroleum spirit; it melts at 78° . That from the former (m.p. 93°) is almost insoluble in these menstrua; it melts at 123° . Further, the latter dinitroxylylene is much more susceptible of reduction than

the former, and, therefore, a fractional or partial reduction may be effected, in which this only is converted. The corresponding nitroacetylides are easily obtained by the action of acetic anhydride upon the nitroxylidines. The melting points of these derivatives are 160° and 149° respectively. The nitroxylidines have been converted into the corresponding diamines; the melting points of the latter are 104° and 64° respectively. The former is obtained by the reducing action of stannous chloride; but to prepare the latter the nitroxylidine requires to be treated with tin and hydrochloric acid.

Triamidometaxylenes, 1, 3-4, 6, 2 corresponding to the trinitro derivatives above described, was obtained from the latter by reduction with stannous chloride. It is an unstable compound, decomposing, when heated, at 140-150°.

Colouring Matters from the Di- and Triamines.—On diazotating these compounds, and employing the products for dyeing silk, in a soap bath, the shades obtained were red brown (diamine m.p. 64°); yellow brown (diamine m.p. 104°); olive green (triamine). With diazo-benzene sulphonic acid, the corresponding colouring matters obtained from these compounds were yellow orange, red orange, and reddish black. The results obtained in dyeing silk with these derivatives were, however, of a different order; the latter became a bright yellow; and deeper shades were obtained from the two former in the inverse order. The investigation of these products is proceeding.

Nitration of Metaxylidene, 1, 3-4. In presence of eight parts H_2SO_4 , the two nitroxylidines previously described were obtained; the isomeride, melting at 78°, constituted ten per cent. of the mixture. From the nitroxylidines the amido group was eliminated by the action of ethyl-nitrite in presence of sulphuric acid and absolute alcohol. The resulting nitrometaxylenes complete the proof of the constitutional relationships of these several compounds, which are as follows:—

	1, 3-4, 6		1, 3-4, 2
Dinitroxylenes...	m.p. 93°		m.p. 82°
Nitroxylidine...	m.p. 123		m.p. 78
Diamine	m.p. 104		m.p. 64

—C. F. C.

The Production of Violet and Blue Colouring Matters of the Rosaniline Series by treating Aromatic Amines with Alkylised Amido Derivatives of Benzoyl Chloride. C. D. Abel, London. From the Farbwerke vormals Meister, Lucius and Brüning, Germany. Eng. Pat. 4961*, March 15, 1884.

THIS is an amended specification of the patent No. 4961, of 1884, the amendment consisting in the excision of the second claim, and the parts relating thereto, which the inventors now declare to have been too broadly stated.—R. M.

Process for the Partial Separation of Schäffer's Monosulphonic Acid from the α -Monosulphonic Acid of β -Naphthol. H. J. Baddan, Westminster. From the Farbenfabriken vorm. Fr. Bayer & Co., Germany. Eng. Pat. 8390, May 29, 1884.

THE object of this invention is to remove the greater part of Schäffer's acid from the β -naphthol- α -sulphonic acid by a cheaper process than the treatment of the sodium salts with alcohol. Three processes are given:—(1) By the fractional crystallisation of the Ba or Ca salt four-fifths of Schäffer's acid can be removed. (2) On neutralising the strong solution of the mixed acids with alkaline carbonates, four-fifths to five-sixths of the salt of Schäffer's acid separates out. (3) The mixed acids are mixed in the state of strong solution with about two-thirds the quantity of alkali necessary for neutralisation. On cooling, about four-fifths of the acid salt of Schäffer's acid separates. The filtrates obtained from either of these processes can, if necessary, be completely freed from the remaining traces of Schäffer's acid by any of the known methods, such as treatment with diazo salts, etc.—R. M.

Improvements in the Manufacture of Colouring Matters suitable for Dyeing and Printing. C. D. Abel, London. From the Farbwerke vormals Meister, Lucius and Brüning, Germany. Eng. Pat. 8744, June 9, 1884.

THIS invention relates to the production of azo colouring matters from the diamido derivatives of "oxy-sulphobenzide." The preparation of these compounds is illustrated by the production of "diamido-oxy-sulpho-orthotoluide," one of the homologues, for which purpose two parts of orthocresol and one part H_2SO_4 are heated to 180° to 190° C. till a sample gives a solid precipitate with water. The oxy-sulpho-orthotoluide is then collected, washed and nitrated by boiling with dilute nitric acid. The dinitro compound is then reduced, and the diamido base is described as furnishing well-characterised crystalline salts. Substitution products, such as the dibromdiamido-oxy-sulphotoluide, etc., are obtained by brominating the dinitro compounds and then reducing. In order to prepare the colouring matters, the dilute solution of the hydrochloride of the base is diazotised and mixed with alkaline solutions of the naphthols, or other phenols, and their sulphonic acids.—R. M.

Improvements in the Process of combining certain Diazo Compounds with Phenol, Cresol, Naphthol and the Sulphonic Acids of these Bodies for the Production of Colouring Matters. A. M. Clark, London. From Wirth & Co., agents for Rudolph Krügener and the Farbfabrik vorm. Brönnner, Frankfurt-on-the-Main, Germany. Eng. Pat. SS06, June 10, 1884.

IN the usual processes for combining diazo compounds with phenols, the former are mixed with the alkaline solution of the latter, kept cool by ice. According to the present invention, certain of the more stable diazo compounds, such as diazomethylphenylsulphonic acid and diazobenzene-sulphonic acid, combine with naphthol and other phenols when dissolved in acetic acid in the presence of sodium acetate. The colours obtained by this method are said to be purer than those given when alkali is used, and the inventor claims, as an advantage, that the use of ice can be dispensed with. The colours are, moreover, said to be isomeric, and not identical with those precipitated by the alkaline method. Detailed examples, illustrating the mode of working, are given in the specification.—R. M.

Improvements in Producing Yellow Colouring Matter suitable for Dyeing and Printing. John Erskine, Glasgow. From the Farbenfabriken vorm. F. Bayer & Co., Germany. Eng. Pat. 9162, June 19, 1884.

THE colouring matter in question is prepared by diazotising benzidine and combining the tetrazodiphenyl with salicylic acid, phenol or cresol. It is a fine yellow colouring matter, which dyes cotton in a boiling soap bath without the use of a mordant.—R. M.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Relative Value of Tartar Emetic and Antimony Oxalate as Mordants. G. Hirzel. Chem. Zeit. 9, 725.

THE comparative tests made by dyeing with these two mordants show that for equal weights of antimony oxide in the two compounds, the tartar emetic produces the best effect, the acid character of the oxalate deteriorating from the brightness of the colour. The oxalate forms in a hot dilute solution a basic salt, which no longer combines with tannin, and, moreover, the oxalate calculated for the same weight of antimony is more costly than tartar emetic.—J. B. C.

Improvements in Bleaching. F. A. Gatty & Brother, Acerington. Eng. Pat. 8470, May 31, 1884.

THIS invention relates to a means of preserving the colours when bleaching fabrics made from white and

coloured yarns. The fabrics are run in an open beek or cistern for about 20 to 30 minutes in soap and water, at a temperature of 120° to 180° F., or more or less according to the colours. Oil or fat soap is used, and in such quantity as to give a froth on the water. After soaping, they are washed and squeezed, then passed through bleaching-liquor at 1° to 4° Tw., squeezed again, and then steamed for one or two minutes, as if for restoring whites after dyeing and printing. After steaming, the fabrics are washed and dried. Sometimes, when the colours can sustain it, the fabrics are passed through very dilute sulphuric or muriatic acid.—H. A. R.

Improvements in Bleaching. J. B. Thompson, New Cross, Kent. Eng. Pat. 9312, June 23, 1884.

This invention relates to improvements in the prevention of bowking stains, and the partial removal of the organic colouring matter in the material treated. Advantage is taken of the well-known affinity of aluminium in certain forms for vegetable-colouring matters. To the bowking alkali, aluminium is added in various forms—e.g., as ordinary trihydrate, finely-powdered gibbsite, or even as finely-powdered kaolin, or finely-powdered cyanite. The first two are used with an alkaline carbonate, with the last two a caustic alkali may also be used, the proportions recommended being from 60lb. to 80lb. caustic soda to the ton of cloth, with about 80lb. of gibbsite or artificial trihydrate. Quantities and proportions vary according to material treated. Artificial trihydrate may also be formed on the fibre by precipitation from aluminium chloride, or another aluminium salt, on the cloth itself. In this case the cloth is piled direct from the aluminium solution into the boiling kier, and there treated by the soda-ash solution. After boiling for five or six hours, the material is thoroughly washed, and is then ready for treatment with calcic hypochlorite in conjunction with carbonic anhydride, according to Eng. Pats. 595 of February 3, 1883, and 4707 of March 11, 1884.—H. A. R.

VII.—ACIDS, ALKALIS, AND SALTS.

Decomposition of Salts by Water. H. le Chatelier. Compt. Rend. 100, 737.

From general principles the author comes to the following conclusions:—(1) That the quantity of free acid necessary to prevent the decomposition by water of a dissolved salt must increase with the quantity of the salt present; (2) That the decomposition of a salt is increased or diminished by rise of temperature according as the decomposition is endothermal or exothermal.

The conclusions were quite borne out by experiments with mercuric sulphate and antimonious chloride. In the decomposition of mercuric sulphate heat is absorbed, and a rise of temperature increased the decomposition, whilst with antimonious chloride a small quantity of heat is evolved and the decomposition is diminished by rise of temperature.—A. G. G.

On the Preparation of Ammonia Gas. Isambert. Compt. Rend. 100, 857.

The reaction in the ordinary preparation of ammonia from NH_4Cl and CaO corresponds to an absorption of heat of 10°9cals., from which 7°55cals. are to be deducted for the formation of Ca(OH)_2 . At ordinary temperatures no ammonia is set free, even in vacuū, but the compound $\text{CaCl}_2(\text{NH}_3)_2$ is formed, in the formation of which about 14cals. are evolved, and which only gives off ammonia at 180–200°. This is also the case with baryta and strontia; but with lead oxide, on the contrary, ammonia is evolved at the ordinary temperature, although the reaction requires an absorption of heat of 12°9cals. The author explains these phenomena by assuming a dissociation of the ammonium chloride; lime or lead oxide fix the hydrochloric acid even at ordinary temperatures, and cause to be yielded free ammonia or ammonia combined to form an ammonium-metallic-chloride. Barium and strontium do not act

sensibly on the free acid below 180–200°. In the foregoing reactions, therefore, the heat of combination of NH_3 and HCl (42°5cals.) should not be taken into account, but the reaction is limited to the separation of the gases set free by a process of dissociation, the necessary heat being borrowed from neighbouring bodies. The formation of an ammonium-metallic-chloride rather hinders than aids the evolution of ammonia.—A. G. G.

The Preparation of Double Cyanides of Chromium and Manganese analogous to the Ferro- and Ferricyanides. Odin F. Christensen. J. f. Prakt. Chem. 31, 163.

THE double cyanides of chromium and manganese have been already prepared by Hridsburg, Kaiser, Eaton, Fittig and Descamps.

Potassium Chromicyanide $\text{K}_6\text{Cr}_2\text{Cy}_{12}$.—A solution of chromic acetate is prepared by dissolving freshly-precipitated chromic hydrate, from K_2CrO_7 , in acetic acid; after removing the excess of acetic acid, potassium cyanide is added to the nearly boiling solution, filtered and allowed to crystallise. After recrystallisation it forms light yellow crystals.

Potassium Chromocyanide $\text{K}_3\text{Cr}_2\text{Cy}_{12} \cdot 6\text{H}_2\text{O}$ is prepared by the addition of potassium cyanide to a solution of chromous acetate formed by mixing solutions of sodium acetate and chromous chloride. It forms a dark-blue crystalline precipitate which is very oxidisable, so that air must be excluded in its preparation.

Potassium Manganicyanide $\text{K}_6\text{Mn}_2\text{Cy}_{12}$, prepared by dissolving manganic phosphate in potassium cyanide, and recrystallised from water containing potassium cyanide.

Potassium Manganocyanide $\text{K}_3\text{Mn}_2\text{Cy}_{12} \cdot 6\text{H}_2\text{O}$ was prepared according to the method of Eaton and Fittig. The salt is blue.—A. G. G.

The Basicity of Hyposulphuric Acid. H. Trey. J. f. Prakt. Chem. 31, 223.

KOLBE was of the opinion that hyposulphuric acid (dithionic acid) was monobasic, as experiments made to prepare an acid salt, a salt with two bases, an acid ether or an acid amine gave negative results. According to Oswald, a difference exists between a mono- and a polybasic acid, the latter dissolving less readily certain slightly soluble compounds, in presence of the neutral salts of the polybasic acid in question, whereas the contrary is the case with a monobasic acid. A similar result might be expected by the action of the acids with their salts on methylacetate. The action of hyposulphuric acid was analogous to that of hydrochloric acid, and it is therefore monobasic. Its composition is therefore HSO_3 , according to Kolbe SO_2OH , in which sulphur acts as a pentad element.—J. B. C.

Solubility of Salts. Fr. Rüdorff. Ber. 18, 1159.

If a saturated solution of a mixture of two salts is prepared, and a large excess of either of the components is then added, dissolved by heat and left to crystallise out again, in the case of some pairs of salts the resulting solution will be found to contain a larger quantity of the salt added, but a smaller quantity of the other salt than before the addition; thus a replacement of the one salt by the other has taken place. This is always the case when the two salts used form with each other a double salt, or are isomorphous. For instance, a saturated solution was made of ammonium-aluminium sulphate, and to one portion of 20cc., 6grm. of aluminium sulphate were added, and to another equal portion 4grm. of ammonium sulphate; 100grm. of the solutions at 18° were then found to contain: (a) Original solution—1·42grm. $(\text{NH}_4)_2\text{SO}_4$ and 3·60grm. $\text{Al}_2(\text{SO}_4)_3$. (b) With excess of aluminium sulphate—0·45grm. $(\text{NH}_4)_2\text{SO}_4$ and 16·00grm. $\text{Al}_2(\text{SO}_4)_3$. (c) With excess of ammonium sulphate—20·81grm. $(\text{NH}_4)_2\text{SO}_4$ and 0·29grm. $\text{Al}_2(\text{SO}_4)_3$. Thus in (b) an expulsion of ammonium sulphate by aluminium sulphate has taken place, and in (c) an expulsion of aluminium sulphate by ammonium sulphate. Such pairs of salts are magnesium and zinc

sulphates, cupric and ferrous sulphates, potassium and ammonium nitrates, ammonium-cadmium sulphate and ammonium-cupric sulphate, iron-ammonium alum and aluminium-ammonium alum, etc. On the other hand, in the case of salts which do not crystallise together, this expulsion does not take place, but the solution will contain the same proportion of the two salts independently of whether there is an excess of one or the other. Such pairs of salts are copper and cadmium sulphates, zinc and cadmium sulphates, copper and beryllium sulphates, lithium and copper sulphates, sodium and nickel sulphates, sodium and copper sulphates, sodium chloride and barium chloride, lead and sodium nitrates, sodium sulphate and sodium phosphate, etc.—A. G. C.

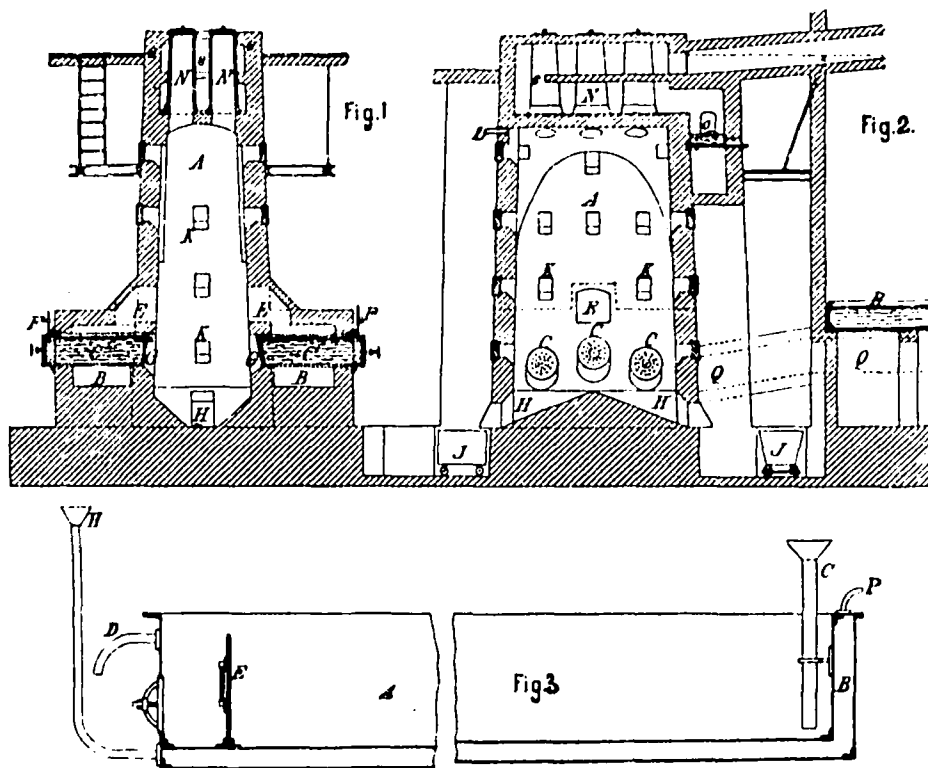
The Preparation of Strontium Oxide. H. Leplay.
Dingl. Polyt. J. 256, 169.

THE author, having observed that in the decomposition of strontium carbonate by means of superheated steam, the strontium hydrate formed loses water at temperatures near its melting point, and is converted into a solid mass of strontium oxide, has devised the furnace and process here described for producing the oxide. The moist strontium carbonate moulded into suitable forms is deprived of a portion of its moisture and warmed in the retorts N placed above the decomposing furnace A. The interior of A is heated to redness by the furnace B, the gases from which enter A through E, charged with native carbonate of strontium in large lumps, and when the whole is sufficiently hot, the flues E are closed and

the precipitation of sugar, a double pan of form shown in Fig. 3 is employed. The liquors flow into the inner pan A through C, are cooled by the aid of the current of water flowing through B in an opposite direction, deposit their strontium hydrate, which is collected by E, and flow away through D.—W. D. B.

On the Densities of Solutions of Pure and Commercial Aluminium Sulphate, and on the Solubility of Alum in Solutions of Aluminium Sulphate. Karl Reuss. Ber. 17, 2888.

THE materials from which alum was formerly prepared were Roman alunite and alum shale, both of which were roasted, the former yielding alum at once, the latter after addition of potassium sulphate. The percentage of aluminium sulphate in the alum obtained from the shale could not be determined from its density, on account of the large quantity of sulphate of iron present, and the strength of the alum was calculated from Poggiale's tables of solubility of potash alum. Now, however, alum and aluminium sulphate are usually prepared by treating bauxite and alunite with sulphuric acid. Bauxite yields a very pure aluminium sulphate, and alunite a concentrated solution of alum in aluminium sulphate, the latter being left behind in an almost pure state after crystallisation of the alum. The author gives tables representing the densities of solutions of pure and commercial aluminium sulphate, containing from 1 to 25 per cent. of sulphate, and at temperatures 15°, 25°, 35° and 45°. At 15° he finds the density of the pure solution to be re-



the hot gases from B led away through Q for purposes of evaporation. The lumps of partially dried carbonate are allowed to fall in from N, steam being introduced at E, superheated by passing through C, and liberated carbonic acid passing away through L. The strontium oxide formed is removed at the bottom of the furnace through doors H into waggons J. A fresh quantity of carbonate, equal to that removed at H, is introduced from N, the retorts in their turn being filled up. The process is thus practically continuous. Sight-holes K are provided at intervals. For separating the excess of strontium hydrate from the mother-liquors obtained in

presented by the equation $d = 1.007 + 0.01p$, where p = percentage of pure anhydrous aluminium sulphate. Experiments on the solubility of alum in solutions of aluminium sulphate were made by adding 4, 3, 2 and 1 per cent. respectively of anhydrous potassium sulphate to solutions of aluminium sulphate of various strengths, heating the mixture to 80° and allowing to cool. With the larger quantities of potassium sulphate, alum separated in every case; with 1 per cent. very little crystallised from a 7 per cent. aluminium sulphate solution, and none at all from a 6 per cent. solution. The density of the 6 per cent. solution after addition of potassium sul-

phate was 1.083 at 15°. The author concludes that in order to use as little potassium sulphate as possible it is necessary to employ solutions of aluminium sulphate containing more than 7 per cent.—S. Y.

The Removal of Arsenic from Sulphuretted Hydrogen.
Otto Frhr. v. d. Pfordten. Ber. 17, 2897.

It is frequently necessary to obtain sulphuretted hydrogen free from arsenic, especially in cases of poisoning. Up to the present time it has been customary to employ materials perfectly free from arsenic, but ordinary ferrous sulphide is by far the most convenient substance which can be used, and it is not always easy to obtain hydrochloric acid quite free from arsenic, hence an easy method of removing arsenic from crude sulphuretted hydrogen would be of great advantage to chemists.

When sulphuretted hydrogen containing arseniuretted hydrogen is heated, three reactions may occur: The decomposition of the hydrogen sulphide, which takes place between 350° and 400°; the decomposition of arsine, which occurs at a higher temperature; and the mutual reaction of the two gases, forming arsenious sulphide and hydrogen, which is effected at 350-360°, but is not complete at this temperature, even when the gas is passed through a tube filled with charcoal. If, however, the impure gas is passed through a tube containing potassium polysulphides (liver of sulphur or potassa sulphurata) heated to 350°, the arsenic is completely removed. It was found best to heat the tube in an air bath. If the presence of hydrogen was not injurious, it was not necessary to maintain the temperature accurately at 350°. The gas was dried in the usual manner, and, after leaving the heated tube, was washed by passing it through a wash-bottle containing a solution of sodium carbonate. Numerous experiments showed that the removal of arsenic was complete, and that with ordinary reagents the tube need not exceed 30cm. in length. The author explains the reaction by the equation $2AsH_3 + 3K_2S_2 = 2AsS_2K_3 + 3H_2S$.

—S. Y.

On the Dissociation of Nitrogen Peroxide Gas. E. and L. Natanson. Ann. Phys. Chem. 24, 454.

THE authors have examined the specific heat and vapour density of nitrogen peroxide vapour under variable pressure and constant temperature. Kundt's method served for the determination of the specific heat. For measuring the vapour density the authors invented a special apparatus. The vapour was evolved in a closed space, which could be connected with another chamber as soon as the "equilibrium of dissociation" had taken place. In the second chamber air was approximately under the same pressure which prevailed in the first space. The small difference of pressure in the narrow connection tube, the pressure of the air in the second chamber, the cubic contents of the apparatus and the weight of the vapour are the data for calculating the vapour density. Further details, the mode of calculation and several results of experiments are to be found in the original paper. The observations were made at 21° C. and between the pressures of 43 and 640mm. The vapour density increases between these limits from 2.024 to 2.762, whereas the specific heat decreases from 1.274 to 1.172. Nitrogen peroxide thus behaves differently from carbonic acid, nitrous oxide, ammonia or ethylene, whose specific heats increase with rising pressure. The authors think these experiments a new argument of the view that the alteration of the density of nitrogen peroxide vapour is due to the dissociation of N_2O_4 in NO_2 .

—S. H.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Process for Glazing Dutch Tiles. Dingl. Polyt. J. 256, 191.

ACCORDING to Krzen, the air-dry tiles free from dust are washed with a solution of glue of 50° B., and allowed to

dry in the air. 100 parts of potter's glaze, with 5 parts of white burning clay, are mixed with a sufficient quantity of a solution of glue prepared by diluting 1 part of glue solution of 50° B. with 3 parts of water. The tiles are immersed in this mixture and treated subsequently as usual. An addition of acetic acid is made to the glue solution to prevent its gelatinising, and also to obviate the too rapid setting of the glazing mixture. If the solution contain too much glue the proper distribution of the glaze is rendered difficult.—W. D. B.

On the Action of Strongly-compressed Carbonic Acid on Glass under the Influence of Light. L. Pfaundler. Ann. Phys. Chem. 24, 493.

THE author casually found that carbonic acid can attack glass under certain circumstances. The surface of a glass tube partially filled with liquid carbonic acid turned opaque in those places which were acted upon by the concentrated light of a Drummond lamp. This alteration already takes place after an action of a few minutes' duration. The opaque spots were always above the surface of the liquid carbonic acid, and the tube being partly immersed in a water-bath, nothing but light could have caused the opaqueness. This behaviour of carbonic acid may perhaps lead to an explanation of Bunsen's observation on the condensation of carbonic acid by glass surfaces (see Ann. Phys. Chem. N.F. xx. 545, and N.F. xxiv. 321; also Ber. 18, Ref. 249).

—S. H.

The Production of Milk-glass. A. Tedesco. Ger. Pat. 31,112, November 4, 1883.

THE inventor proposes to employ an alkaline fluoride in the place of cryolite. The fluoride is most advantageously prepared by the incomplete saturation of carbonated or caustic alkalis with hydrofluoric acid and subsequent evaporation of the alkaline reacting product. The ordinary mixture for milk-glass consists of 25 parts of soda, 25 parts cryolite, 10 parts chalk, 170 parts sand. A precisely similar glass is obtained by the use of 33 parts of sodium fluoride, consisting of 90 per cent. of fluoride and 10 per cent. of carbonate, 5 parts of soda, 15 parts of china clay, 10 parts of chalk, 156 parts of sand. An alkaline fluoride may also be employed in the production of enamels for metallic surfaces.—W. D. B.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, CEMENTS.

Preparation of Grey, Blue and Black Clay. Dr. Carl Bischof, of Wiesbaden. Deutsche Töpfer und Ziegler-Zeitung, 12, 1885.

THE manifold tints exhibited by different varieties of clay, as is well known, are mainly due to the admixture of carbonaceous or ferruginous matter. More particularly the latter—viz., the several oxides of iron cause the originally white silicate of alumina to change its colour, which is the more readily perceived on account of the moisture of the material. The grey, bluish, and even black colouring, caused by carbonaceous and other organic matter, disappears completely on burning with access of air. If white clay be triturated with bright and colourless water, such as distilled rain-, well-, or spring-water, and then after subsidence be collected on a filter, a residue of the original colour is obtained. Blue clay is not decolourised by digesting with hydrochloric acid. On heating, the colour at first appears more intense, owing to the separation of particles of carbon, but it finally disappears. Some other curious points were observed in connection with water containing brown peaty matter, which had been filtered. Finely-decanted Bohemian kaolin settles down extremely slowly when being mixed with such water. After 24 hours' standing,

the mixture was still distinctly turbid and milky, whilst the same clay, mixed with distilled water, had settled down completely. The following table explains what took place:—

Appearance of Water.	Bright Distilled Water.	Filtered Shallow Well Water.	Filtered Rain Water.	Clear, Filtered, Brown Water from Stagnant Pond.
After 12 hours....	Almost Bright.	Almost bright (opaque).	Slightly turbid.	Very turbid (milky).
" 21 "	Bright.	Bright.	Almost bright.	Turbid.
" 60 "	—	—	Bright.	"
" 8 days	—	—	—	Slightly turbid.
" 12 "	—	—	—	Bright (faintly milky).

After such brown water has been treated several times with clay, its clarification becomes more and more rapid. The evolution of gas due to microbes, which always abound in such waters, probably tends to keep the particles of clay in suspension. Any affinity of the clay to the brown colouring matter, preventing the settling of the clay, is apparently lessened after a time, when the finest clay particles agglomerate more and more, whilst also they are saturated more rapidly with the colouring matter. Thus these particles subside more freely and rapidly. The colouration of clay, even by brown peaty water, is but a slow process. White kaolin was mixed with such a sample of water, and after eight days' standing, the slightly turbid liquid decanted. The residue having been transferred to a doublepaper filter, was of a brownish bluish tint, which became more distinct on being dried. Treated a second time in like manner, a brown residue resulted, and so on, until after ten repetitions of the treatment, a dark blue clay, with a brownish tint, was obtained, very similar in colour to many natural clays. The plasticity of clay is increased as the colouration gradually becomes more intense, and at the same time a faint lustre is perceived. Thus all the properties exhibited by natural coloured plastic clay are to some extent at least obtained by artificial means. As the plasticity increases, the clay after drying loses its power of staining one's fingers, but its hardness is increased.

—G. B.

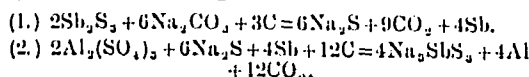
Improvements in the Treatment of Slurry or Slip in the Manufacture of Portland Cement. H. Fajja, Westminster. Eng. Pat. 2161, February 17, 1885.

ACCORDING to this invention, the slurry, after it has left the wash mill, is treated in a centrifugal machine, revolving rapidly, and provided with a sieve, which may be of any desired fineness. The mechanical admixture of the raw materials, after they have left the wash mill, is thus completed most effectually, while small particles of chalk, such as in the wet process of manufacture would evidently be burned into free lime, and thus tend to produce a faulty cement, are removed from the slurry or slip.—E. G. C.

X.—METALLURGY, MINING, Etc.

Progress in Metallurgical Practice. Dingl. Polyt. J. 256, 227.

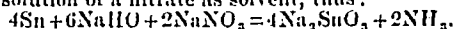
For the production of aluminium, Lauterborn charges a furnace with coke, brings this up to the requisite temperature with an air-blast, and then introduces a mixture of aluminium sulphate, sodium carbonate, and antimony sulphide. The following reactions are said to occur:—



The sodium sulphantimonate is fused with soda, and the antimony thus obtained in a condition suitable for repeated operations.

In order to obtain ammonia during the operation of removing tin and zinc from metal waste, Reinocken-

(Ger. Pat. Add. 30,254, March 8, 1884) employs an alkaline solution of a nitrate as solvent, thus:



The last portions of tin are removed by treating the

waste with a solution of ferric chloride and dilute hydrochloric acid. The tin is precipitated from the liquors obtained by means of zinc.

For the removal of gold and silver from copper regulus, Mauhès (Ger. Pat. 30,419, July 22, 1884) grinds the latter to a powder, mixes with from 1 to 3 per cent. of ammonium chloride, and heats in a muffle to temperatures below redness, till ammoniacal fumes are no longer given off. The regulus has not altered in appearance, but the gold and silver are now in the form of chlorides, the iron and copper being still combined with sulphur. The chlorides of gold and silver are extracted by any of their solvents, preferably sodium thiosulphate.

Probert recommends the plan of melting arsenic and sulphur ores containing gold and silver with litharge or lead in crucibles lined with dolomite.

According to Howard's patent, copper ores are decomposed with a mixture of potassium hydrogen sulphate, fluorine acid, sodium nitrate, sulphuric acid, and water. The electricity thus generated is utilised in the precipitation of copper in another bath.

Referring to recent discoveries of gold in the island of Bismellöen on the west coast of Norway, Weltz considers that there are slight grounds for the hope of obtaining the same in noteworthy amount. Traces of native gold have been found in Norway for forty years past.

Symons describes a plan adopted at Maidanper, Servia, for the extraction of copper from poor ores, containing, upon an average, copper sulphide 1.05, blue and green carbonate 0.30, red copper ore 0.95, water 16.00 per cent. The ore was made into heaps of 300 tons, allowed to dry for a month, then roasted with seven tons of dry beechwood. The roasted mass was lixiviated, the copper precipitated from the liquors by cast-iron rods, cast into blocks, and brought into the market as black copper.

Brand contributes his experiments in relation to the steel-melting processes in acid and basic crucibles. The puddled iron (I.) and spiegel iron (II.) employed were composed as follows:—

	I.	II.
Silicon	0.079	0.888
Copper	0.090	0.141
Manganese	0.140	12.07
Nickel and Cobalt	0.043	0.169
Sulphur	0.030	0.012
Phosphorus	0.231	0.076
Carbon	0.020	4.25

Experiments were made with three different "acid" crucibles, and one "basic." The composition of the substance of the crucibles was found by analysis to be as under:—

	Acid.			Basic.		
	(1) Coke-Clay.	(2) Graphite.	(3) Clay.			
Silicic Acid	42.78	24.63	53.92	4.8		
Alumina...	31.71	27.89	40.57	2.49		
Magnesia..	—	—	—	92.02		
Sulphur ...	0.49	0.27	0.23	0.099		
Carbon	18.60	40.43	—	—		

The constituents of the charge worked in the coke-clay crucible, and of the steel obtained, were as under:—

	Charge.	Steel.	
		Sampled when fusion was complete.	Sampled after 24 hours' fusion.
Silicon	0.119	0.096	0.297
Copper	0.092	0.092	0.094
Manganese	0.74	0.360	0.380
Nickel and Cobalt	0.049	0.045	0.047
Sulphur	0.029	0.036	0.051
Phosphorus	0.223	0.223	0.224
Carbon	0.230	0.380	0.530
	1.482	1.232	1.623

The silicon, sulphur, and carbon in the charge, and steel of the graphite crucible were:—

	Charge.	Steel.	
		Sampled 1hr. after fusion.	Sampled 14hr. after fusion.
Silicon	0.119	0.211	0.296
Sulphur	0.029	0.035	0.039
Carbon	0.230	0.810	0.950

In the clay crucible the charge was made up of ninety-two parts soft iron, eight parts of spiegel iron. The analytical results were:—

	Charge.	Steel.	
		0.130	0.178
Silicon	0.143	0.130	0.178
Sulphur	0.028	0.037	0.041
Carbon	0.360	0.330	0.280

The steel from these three crucibles was found to possess a medium grain on fracture, but owing to the high percentage of sulphur showed a tendency to "red-shortness." The above experiments, with different "acid" crucibles, lead to the following general conclusions: High quality steel is adversely affected most of all by sulphur, next by phosphorus and silicon. Copper, nickel, and cobalt have but slight influence, unless they are present in large amount. Their adverse influence can thus be readily prevented. Excess of manganese causes brittleness, but in amounts less than 1.5 per cent. this element partly neutralises the bad effects of silicon, sulphur, and phosphorus. The likelihood of phosphorus increasing during the melting process is but small, since the materials of which the crucible is ordinarily composed do not contain sufficient of this element in the forms of combination in which it can combine with iron. On the other hand, silicon and sulphur readily migrate from the crucible to the steel. Whilst silicon and phosphorus are able in some measure to perform the functions of carbon, carbon, and carbon alone, imparts to steel its elasticity. It follows that the crucible mass should contain as little sulphur as possible; it is also of importance that the amount of carbon should not exceed that which is actually required to give the clay porosity. In the experiments with the basic crucible the charge was composed of ninety-five per cent. of puddled iron, five per cent. of spiegel iron, lime being added to assist the formation of slag, and oxide of iron as the oxidising agent. The following are analyses of the charge and of samples of the steel taken at different intervals:—

	Charge.	Steel I.	Steel II.	Steel III.
Silicon	0.119	—	—	—
Copper	0.092	—	—	0.097
Manganese	0.740	trace	trace	—
Nickel and Cobalt	0.049	—	0.050	—
Sulphur	0.029	0.063	0.065	0.077
Phosphorus	0.223	0.090	0.050	0.043
Carbon	0.230	trace	—	0.018

The steel obtained in this experiment was soft and malleable, and a rolled plate of 1.75mm. in thickness could be subjected to much bending and twisting without fracture; owing, however, to the high percentage of sulphur, the tendency to "red-shortness" was distinct. From a comparison of the above four analyses it is

evident that the reaction was practically completed during the melting up, the percentage of phosphorus alone subsequently undergoing any marked diminution. The difficulty with which phosphorus is oxidised and removed is explicable when it is remembered that ferric oxide is the oxidising agent. Copper, nickel, and cobalt have suffered no reduction; silicon has been completely removed, and the carbon in samples I. and II. is only present in traces. The increase of carbon in sample III. is ascribed by the author to accidental introduction. The increase in the percentage of sulphur is remarkable, and proves with what facility that element is transferred from the crucible to the charge. In this case the sulphur was derived from the far employed in conjunction with the dolomite. The advisability of substituting other carbonaceous substance—as syrup—in place of tar is thus apparent. For the production of a chemically pure iron by a fusion process, a material free from copper, nickel, and cobalt, and containing only moderate amounts of sulphur and phosphorus, should be selected. The sulphur is eliminated by the addition of a considerable amount of manganese before the iron has lost its easy fusibility by removal of its carbon; the sulphide of manganese formed rises to the surface, and either unites with the slag or forms a regulus. The iron now contains only phosphorus, silicon, manganese, and carbon, and these can be eliminated by oxidation with oxide of iron in a basic crucible.—W. D. B.

Extracts from the Review of the Mining Industry during the first Quarter of 1885. Chem. Zeit. 9, 745.

P. MANHÈS, of Lyons (*Chem. Zeit.* 1885, 9, 81; and Ger. Pat. 29,006) obtains nickel and cobalt (after fusion to eliminate gangue), by heating the polybasic sulphur and arsenic compounds of nickel, cobalt, and copper in the Bessemer converter until the iron is almost got rid of. The regulus is then treated with HCl or submitted to electrolysis or fusion. To obtain malleable ferronickel and ferrocobalt from crude nickel and cobalt ores, the latter are fused with cyanide of iron or yellow prussiate of potash and oxide of manganese, and a small quantity of aluminium is added before tapping.

Basse and Selve (*Berg- und Hüttenm.-Zeit.* 1885, 44, 128) in Altena have taken out a patent for the manufacture of cube nickel and cobalt directly from the oxides, and from these malleable alloys may be prepared.

Stetefeld (*Chem. Zeit.* 1885, 9, 233) has sent several communications on the subject of Russell's process for extracting silver from ores in which the solubility of silver chloride in hyposulphite (thiosulphate) solutions is utilised, and the precipitation of such solutions by alkaline sulphides, the hyposulphite being reproduced. If the ore contain lead, the latter dissolves in the hyposulphite, and is precipitated with the silver. Russell found that lead carbonate is insoluble in sodium hyposulphite, silver and copper carbonate being soluble. The lead is therefore precipitated by sodium carbonate. A further factor to be considered in this method is that whereas a complete chlorination of the silver is necessary to the success of the process with hyposulphites (thiosulphates), the solution of double salts of copper and sodium hyposulphite dissolve considerable quantities of silver, silver sulphide and the compounds of silver with arsenic and antimony.

Möbins (*Chem. Zeit.* 1885, 9, 160; and Amer. Pat. 310,302) gives methods for purifying silver by electrolysis, and for the separation of gold with bromine and hydrobromic acid.

P. Manhès, of Lyons (*Chem. Zeit.* 1885, 9, 339; and Ger. Pat. 30,419), heats powdered gold and silver ores, without previously roasting with ammonium chloride, in order to convert the noble metals into chlorides.

Katterfeld, of Strassburg (*Chem. Zeit.* 1885, 9, 435), has published an interesting report on the platinum production of Russia, an industry which has increased largely in recent years.

N. W. Perry (*Chem. News*, 1885, 51 [1], 19, 31) has given an account of the occurrence, properties, and processes of fusing, casting, dephosphorisation and moulding of iridium.

F. A. Reinecken (*Chem. Zeit.* 1885, 9, 196; and Ger. Pat. 30,254) combines the process of recovering tin and zinc from metallic residues with the production of ammonia by heating these metals with nitre and alkali, thus forming sodium and ammonium stannates.—J. B. C.

Cellular Structure of Cast Steel. Osmond and Werth. *Compt. Rend.* 100, 450.

SMALL plates of cast steel, from 0.02 to 0.03mm. thick, fixed to glass by means of Canada balsam, were treated with cold dilute nitric acid, when the iron dissolved, leaving a carbon compound behind. A microscopical examination of the plates showed that cast steel possesses a cellular structure, the iron occupying the interior, and the carbide of iron forming the cell wall. The cells unite to form groups, which, in the thin plates, are seen to be separated by empty spaces, and therefore possess no walls. If a bar of cast steel is dissolved at the positive pole of a Bunsen cell in dilute hydrochloric acid, the residue, consisting of small spangles, preserves the original form. These spangles form a network, the meshes of which were filled with iron. If a polished surface of cast steel is etched with concentrated nitric acid, the dendritic structure of the cell-groups is seen. In tempered steel, only simple cells are found. The interior of the cells is elongated by hammering, and the cell walls, which are but little extensible, more or less obliterated.—S. Y.

The Treatment of Basic Slags. II. Schüchtermann. Ger. Pat. 30,891, April 8, 1884.

SLAGS obtained from the basic process are finely divided, freed as far as possible from metallic iron, mixed with solution of calcium chloride, dried and calcined in presence of water vapour. Sulphuric, phosphoric and silicic acids, previously combined with oxides of the heavy metals, now enter into combination with lime, and the phosphates may be readily obtained therefrom by proceeding according to well-known methods.—W. D. B.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

Experiments with Lubricating Oils. S. Lamansky. *Dingl. Polyt. J.* 256, 176.

IN the experiments of which the results are to be enumerated first, the apparatus of Napoli and Deprez was employed, since with this it was possible always to subject known quantities of oil to the test. From the tabulated results of these experiments, the conclusions to be drawn are:—The coefficient of friction is dependent upon viscosity; liquid oils will not carry a heavy load, but have the smallest coefficient of friction; viscid oils, such as ricinus, among organic, and Glück cylinder oil among those of mineral origin, show a large coefficient of friction with a proportionately small load. These oils can only be employed successfully for the lubrication of light machinery when the parts in contact therewith are warmed. Experiments were also made by the aid of the same apparatus with oils of small viscosity—viz., sperm, olive, and a light mineral oil "oleonide,"—with a view of determining what relation obtained between velocity and friction. It was found that an increase of friction corresponds with an increase of velocity, but that the influence of velocity upon friction is more marked with small and heavy than with medium loads. The influence of temperature upon the lubricating powers of a large number of oils was studied by the aid of Thurston's apparatus. The coefficient of friction of mineral oils is easily influenced by changes of temperature, increase of temperature resulting in decrease of viscosity. In fact, the viscosity of ricinus, and the majority of mineral oils, is too readily affected by temperature for these to be regarded as first-class lubricants. In this respect sperm and olive oils show their superiority. The lubricating power of different mineral oils in the market, the viscosity of which varies between 55 and 70, differs very slightly, although these

are sold at widely different prices. Among mineral oils, the author has found that petroleum residues will carry the greatest load, and on this account, and their low price, he recommends their employment in railway axle lubrication. A mixture of equal parts of rape oil and petroleum residues has a smaller coefficient of friction with all loads than the residues alone, but after a certain limit of load is reached, the coefficient of friction of the mixture is more sensitive to an increase of load than the petroleum alone. The author's experiments lead him to recommend, for heavy work, a mixture of equal parts of rape and "waggon" (mineral) oils; this is confirmed by practical experience on the French railways. Mineral and ricinus oils, which, by the aid of Thurston's apparatus, were found to possess a high coefficient of friction, when heated to 75° to 83°, gave excellent results, owing to their thereby decreased viscosity.

—W. D. B.

Extraction of Fat from Bones. Dr. Lorenz. *Chem. Zeit.* 9, 484.

THE author has tested the efficacy of the benzene fat-extraction process, introduced by Seltsam in 1880, and finds that the bones after treatment with benzene still contain 1.6 to 2.5 per cent (on the raw material) of fat, which can be extracted by a further treatment with benzene and 0.48-0.8 per cent., which is dissolved out by ether or a total of 2.08-3.2 per cent. of fat, which is lost in the actual process. This represents a loss of about 25 per cent. of fat. The author concludes that there is still room for considerable improvement in the method of extraction.—J. B. C.

On the Insoluble Residue formed by the Distillation of Castor Oil in Vacuo. F. Krafft and Th. Brunner. *Ber.* 17, 2985.

THIS subject has been studied by several chemists, but their analyses of the product do not agree. The authors distilled castor oil both under reduced and at the ordinary pressure. The residue in the retort, which solidified suddenly, was extracted repeatedly with ether, and macerated between each extraction. The product, now scarcely elastic, was dried in two cases in the desiccator, in three others on the water-bath at a pressure of 15mm. The analyses agreed well together, and fairly with the composition $(C_{11}H_{20}O_2)_n$. They differ widely from those previously published. It appears from them that the product is a polymeric modification of undecylenic acid $C_{11}H_{20}O_2$; it shows great resemblance to Fittig and Engel's methacrylic acid. The product, which resembles caoutchouc, is easily saponified by alkalis, and when fused with potash yields nonylic acid. When heated to 50-60° with four times its weight of fuming nitric acid for several days, it forms sebacic acid. Undecylenic acid when similarly treated gives the same acids, so that the nature of the product is confirmed. When pure undecylenic acid is heated in closed tubes for some hours to 300°, and subsequently distilled, the residue in the retort solidifies suddenly to a light yellow amorphous mass. If, however, the acid, after being heated, is distilled under a pressure of 15mm., unaltered undecylenic passes over first, the temperature then rises rapidly 100°, and between 265° and 275° a product distils over which readily crystallises on cooling, while the above-mentioned yellow solid remains behind. The crystalline body was redistilled, the temperature being allowed to rise to 250°, pressed, and recrystallised from dilute alcohol in a freezing mixture. It melted at 29-30°, and its composition was found to be $(C_{11}H_{20}O_2)_n$, or the same as undecylenic acid. The silver salt has the composition $C_{22}H_{40}O_4Ag$. The acid is therefore monobasic.—S. Y.

Improvements in the Manufacture of Soap. W. Rodiger. Eng. Pat. 3012, June 10, 1884.

IN order to neutralise the free caustic alkali usually present in soap, a strong solution of a bicarbonate of the same alkali (usually soda) is incorporated with the soap-paste at a temperature not far removed from 90° C.

—W. L. C.

Improvements in the Manufacture of Soap. A. Domeier and B. Nickels. Eng. Pat. 9375, June 24, 1884.

A COMPOUND termed in the specification "resinate of glycerine" is prepared by adding excess of powdered colophony to heated glycerine, and continuing to heat and stir for some hours. It may also be prepared by dissolving 4 per cent. of caustic soda in glycerine, and adding thereto 16 per cent. powdered colophony; about 15 per cent. or more of either mixture may be incorporated with soap in the usual way.—W. L. C.

Improvements in Lubricating Oils. Jakob Seeger. Eng. Pat. 13,512, October 13, 1884.

TALLOW, oil of turpentine, and cod-liver oil are mixed, and added to a solution of potash soap in warm dilute alcohol; the whole is stirred and cooled to 90° F., and rape oil is added to the mass. No quantities of the ingredients are given, but special qualities are claimed for the lubricant so produced.—W. L. C.

Improvements in the Preparation of Oils for Medicinal Purposes. W. G. Rudley. Eng. Pat. 1399, January 31, 1885.

To cod-liver and castor oils the patentee adds caustic alkali to neutralise the oleic acid, and then mixes with this emulsion, sugar syrup, glycerin, and aromatic essences, in order to make them more palatable.

—W. L. C.

An Improved Method or Process of Purifying Fat and Oil. H. H. Lake. From J. P. A. Larson. Eng. Pat. 2100, February 14, 1885.

THE patentee renders fit for food various inferior fats, such as tallow and olive oil, by subjecting them to the successive action (1) of steam at 150-250° C., with or without a vacuum; (2) of a mixture of alumina salts and dilute sulphuric acid, at 100° C.; (3) of an alkaline carbonate; (4) of some weak oxidising agent at a low temperature, such as very dilute nitric acid, soluble chromates, etc.—W. L. C.

XII.—PAINTS, VARNISHES, AND RESINS.

Ultramarine-blue from Silica. Fr. Knapp. Journ. Prakt. Chem. 31, 151.

THE author has failed to prepare ultramarine from silica without alumina.—A. G. G.

The Umber Deposits at Ashburton. R. J. Frecheville. Trans. Roy. Geol. Soc. (Cornwall), X. vii. 217.

THESE deposits occur at Ashburton, near Dartmoor, and occur closely associated with deposits of dolomitic limestone. By the alteration and decomposition of the latter the umber has been formed, and the change is indicated in the following analyses by Mr. J. J. Beringer. No. 1 is the analysis of a sample of unchanged limestone, No. 2 that of the umber in its natural state:—

No. 1.	Per cent.	No. 2.	Per cent.
Water (lost at 100° C.)	0.8	Water (lost at 100° C.)	65.0
Carbonate of lime	46.7	Combined water	1.8
Carbonate of magnesia	11.0	Lime	0.6
Silica	3.3	Silica	12.3
Carbonate of iron	2.6	Fe ₂ O ₃	6.3
Carbonate of manganese	2.5	MnO ₂	10.0
Undetermined and loss	3.1	Undetermined and loss	1.0

The carbonates of lime and magnesia have doubtless been removed by the solvent action of water containing carbonic acid, thus giving rise to the formation of deposits of umber from twenty to thirty feet in thickness. The deposit is worked by removing the over burden, consisting of from three to four feet in thickness of loam, and then sinking large rectangular pits in the umber till the unchanged rock is reached. The timber supporting the sides is then removed, the pit filled up, and another commenced alongside. The umber obtained, after being stamped in the usual manner, is ground under edge-runners, and the liquid mud pumped up to tanks, where it remains until it settles sufficiently to be dug out.

The drying is then completed in a manner similar to that practised in the preparation of china clay. The umber is used for making the so-called silicate-oxide paints, as a colouring matter for the coarser kinds of cloth, and in the manufacture of brown paper. The output of umber from this deposit for the year 1883 was 2766 tons, the price of which delivered on rail at Ashburton averaged about 25s. per ton. Small deposits of umber have been found near Milton Abbot and at Vryan, seven or eight miles from Truro, in both cases as a result of the decay of limestone rocks.—W. S.

XIV.—AGRICULTURE, MANURES, Etc.

Composition of Unwholesome Meadow Hay. Morgen. Bied. Centr. 14, 90-91.

THE hay in question, when used as fodder, caused the bones of the animals to become brittle. Two samples were taken and examined; they were found to be very deficient in lime and phosphoric acid. Taking moisture at fifteen per cent.—

	CaO	P ₂ O ₅	Albumen.
Sample 1 contained	0.37	0.20	8.3 per cent.
" 2 "	0.67	0.26	11.9 "

Sample 1 consisted almost entirely of inferior "acid" grasses and weeds, such as *nardus stricta*, *calluna vulgaris*, *carex panicea*, *potentilla*, *juncus* (rushes) and such like, with only two good grasses, *anthoxanthum odoratum* and *agrostis alba*, in very small quantities. Sample 2, with the larger amount of lime, etc., consisted mostly of marshy vegetation; but, nevertheless, with notable quantities of good grasses, such as *holcus lanatus*, *agrostis alba*, *lolium perenne*, etc. Thus it would seem that the amounts of lime and phosphoric acid present form a good indication of the wholesomeness or unwholesomeness of hay.—D. A. L.

Removal of the Bitterness from Lupines. F. Bente. Bied. Centr. 14, 91-92.

LUPINES (100lb.) are immersed for twenty-four hours in dilute hydrochloric acid (containing for 100lb. lupines, 2lb. of strong acid), then a saturated solution of calcium sulphite (2lb.) is stirred in, and after twenty-four hours the liquid is poured off. The lupines are washed by repeated soaking in fresh quantities of water. The seeds, after treatment, are somewhat bleached, are odourless, and destitute of bitter taste. They are eaten readily by sheep, horses, cows and pigs, and when dried may be kept for a long time without spoiling. The air-dried lupine, after treatment, contains 37.28 per cent. albumenoids, and 3.38 per cent. of fat. The process here described occasions a loss of about twenty per cent.; but apparently not including much nutritive matter.—D. A. L.

Formation of Free Hydrochloric Acid in Plants. W. Detmer. Bied. Centr. 14, 108-109.

THE author contends that the organic acids of plants are capable of decomposing metallic chlorides with the liberation of hydrochloric acid. And, as an example of this, he instances the fact that the addition of a trace of chloride promotes the action of diastase on starch, which he explains in the following manner:—The organic acids in the malt extract liberate hydrochloric acid, which favours diastatic action to greater extent than its equivalent of organic acids. If, however, citric acid, alone, and with chlorides, is added to malt extract, the activity of the diastase is greater in the first than in the second case, from which it is inferred that too much hydrochloric acid retards the diastatic action to a greater extent than its equivalent of organic acid. Definite experiments were now made to prove the decomposition of chlorides by organic acids; citric and oxalic acids were employed along with various chlorides. Methyl-aniline violet was used as indicator, inasmuch as it is much more readily affected by hydrochloric than by citric acid. (a) 15cc. distilled water, and (b) 15cc. distilled water containing 0.02grm. citric acid, (c) 0.7grm. potassium chloride, (d) 0.7grm. sodium chloride, (e) 0.02grm. citric acid and

0.7grm. potassium chloride, (f) 0.02grm. citric acid and 0.7grm. sodium chloride. After remaining 18 hours at a temperature of 20-25° C. the solutions were tested with methyl-aniline violet; the colour in (a), (c) and (d) was not changed, in (b) it was slightly changed, whilst in (e) and (f) it was changed to blue, or to the same extent as it would be by very dilute hydrochloric acid. Oxalic acid behaves in a similar manner to citric acid.—D. A. L.

Behaviour of Zinc Salts towards Plants and in the Soil. A. Baumann. Bied. Centr. 14, 117-126.

IN order to investigate thoroughly the much-contested question as to injurious or harmless effect of zinc salts on vegetable life, the author has made a series of water-culture experiments to study the effect, and the limits of the effect, of soluble zinc salts on various plants; and a series of experiments with soils and zinc salts to discover both the effect on the plant and the chemical changes produced in the soil. For the water-culture experiments the solution contained calcium and potassium nitrates, dipotassium phosphate, magnesium sulphate, and iron phosphate. To these zinc sulphate was added in various proportions, so that the four solutions contained 10, 5, 1, and 0.1 milligrams of metallic zinc per litre respectively. Thirteen plants of various kinds were experimented on. Starting from the seeds, these plants were germinated in a similar manner, selected as nearly alike as possible, and cultivated in the above solution at first without zinc. Observations made, when the zinc sulphate was given to the plant, showed the effect to be more injurious than was anticipated. All the plants resisted the influence of the smallest quantity of zinc, and only one—the radish (*raphanus sativus*)—died in the 1 milligram per litre solution. The following resisted the 1 milligram solution, but succumbed to the 5 milligram solution. They are arranged in the order of their susceptibility: Meadow clover, kidney vetch (*anthyllis vulneraria*), spurry (*spergularia arvensis*), vetch (*vicia sativa*), barley, oats, cabbage (*brassica oleracea*), mangold wurtzel (*beta vulgaris*), and buckwheat; whilst sanfoin is not affected by the 5 milligram solution, but dies in the 10 milligram solution. Finally, the 10 milligram solution kills all the plants; the clover in 16 days, barley in 30 days, vetch in 31 days, radish in 46 days, the sanfoin in 194 days. The other plants are intermediate in the order indicated above. The *coniferae*, however (pine and fir), flourish even in the strongest zinc solution. Older plants perish sooner than the younger ones of the same kind. The action of the zinc always shows itself by a change in the colour of the leaves. The effect of zinc sulphate when applied to the soil is, however, quite different, and depends greatly on the character of the soil. To substantiate this statement the following plants—meadow cat's-tail grass (*phleum pratense*), oat grass (*avena arvenatherum*), rye grass, soft meadow grass (*holcus lanatus*), field pea, sweet pea, and cabbage (*brassica oleracea*)—were grown in two kinds of soil, one a chalk soil rich in humus, the other a sandy soil free from humus and poor in lime. The plants were sown in pots, and representatives of each sort were watered daily, some with distilled water, some with a solution of zinc sulphate containing 20 milligrams of zinc per litre, and some with a solution containing double that quantity. In the sandy soil for the first six weeks all the plants were well, and those receiving strongest zinc solution looked most vigorous than any of the other plants. After this period the zinc plants fell off, and ultimately died, the grasses resisting for the longest time. In the calcareous soil matters were different, and not only were the zinc plants not killed, but they even surpassed in development those not receiving the zinc. The cause of these phenomena is plain; the sandy soil did not contain the necessary constituents to make the zinc harmless and insoluble, whilst the humus soil, on the other hand, absorbed the zinc, setting free other valuable plant foods, such as potassium, sodium, and magnesium in a soluble form. This conclusion was confirmed by experiments, wherein various soils were treated with zinc solution, and the quantity of zinc retained determined. The zinc absorbing power is greatest in soils rich in humus; then follow

clayey and calcareous soils, then other soils according to their richness in alkaline earths and humus; finally comes poor sand soil, which has scarcely any retentive power at all for zinc. From direct experiments the author concludes that alumina has great zinc absorptive power without becoming soluble itself; zeolites also decompose zinc sulphate, whilst calcium and magnesium carbonates precipitate the whole of the zinc as carbonate. With regard to insoluble zinc salts, water cultivations with some of the plants mentioned above in solutions containing zinc carbonate or zinc sulphide, proved that these salts were equally as fatal as zinc sulphate, owing to the solubility of zinc carbonate in water containing carbonic anhydride, and to the fact that zinc sulphide under similar conditions is converted into carbonate. This solution does not take place in the presence of calcium carbonate, when it is present in proportions equal to or exceeding four of this salt to one of the zinc carbonate. For the sulphide the quantity required is somewhat less. Therefore, there is no solution of zinc likely to take place in the soil, any way not to any injurious extent, and the author's experiments prove, as well as those of previous investigators, that insoluble zinc salts in the soil are harmless to plants. If, however, a soil should contain considerable quantities of soluble zinc—as, for instance, near zinc mines and works—the author recommends the use of peat, heavy dressings of farmyard manure, and the application of clay, marl, or chalk. Certain zinc powders have been offered in the market for use on the soil; it is scarcely necessary to add that such an application is strongly deprecated. The poisonous action of the zinc on the vegetable organism evidently consists in a destruction of the chlorophyll colouring matter, inasmuch as neither the development of vegetation in the dark, nor the growth of plants containing no chlorophyll, is affected by zinc.—D. A. L.

Manurial Value of Peat Waste and Concentrated Liquors from the Strontium Sugar Factories. Mäcker. Bied. Centr. 14, 140.

THIS manure contains from 2.5 to 3.3 per cent. nitrogen, of which about 0.16 to 0.20 per cent. is derived from the peat, and is only of small value; the greater part comes from the roots in the form of nitrates, ammoniacal compounds, amides and amido-acid, and is of the same value as ammoniacal manures. The potash amounts to from 11.5 to 14 per cent., and as it is not accompanied by any of the other salts, which so frequently render the impure Stassfurt manures injurious, it forms an additional qualification to recommend the mixture of peat and waste liquor as a valuable manure.

—D. A. L.

Amount of Nourishment and Alkaloids in Different Varieties of Lupines. Dr. E. Flechsig and Dr. E. Taeuber. Die Landw. Versuch. 1883, 451.

TWELVE varieties were grown under the same conditions of weather, manure, and soil; the seed was examined for proteids, fat, etc., and alkaloids, the straw for woody fibre, ash, etc. The most nitrogenous seeds were accompanied by the most nitrogenous straw, and the latter contains the largest proportion of ash. The figures are interesting, and should be consulted.—J. R.

Feeding Experiment with Lupines. Sächs. Landw. Zeit. 1884, 441.

THE Lupines had been treated by a patent process to remove bitterness, and were found to increase the yield of milk from a cow, but neither to injure it nor affect the flavour of the butter. Horses eat sparingly, and pigs refuse them.—J. R.

Manurial Value of Freshly-fallen Leaves of Trees. Emmerling, Loges, and Emeis. Bied. Centr. 14, 87-90.

FRESHLY-FALLEN leaves from—1. grey poplar; 2. white willow; 3. silver poplar; 4. hornbeam; 5. birch; 6.

sycamore; 7. alder; 8. oak; 9. beech—were found to contain—

Water per cent.	1. 20.88	2. 20.27	3. 18.31	4. 17.03
" "	5. 15.73	6. 17.74	7. 17.09	8. 17.73
" "	9. 15.35			

and in 100 parts of dry matter:—

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Albumenoids	11.52	16.71	12.51	7.57	5.05	6.39	18.71	7.07	6.57
Fat.....	5.09	5.15	8.12	3.86	12.58	6.39	6.91	5.73	3.66
Carbo-hydrates	18.11	51.38	51.06	60.31	50.70	52.10	55.21	52.57	55.49
Woody fibre	26.11	19.72	20.16	21.83	29.10	28.31	15.71	30.68	29.82
Ash	7.51	7.01	7.55	3.13	2.57	6.81	3.10	3.95	4.16
Nitrogen.....	1.813	2.681	2.001	1.212	0.808	1.022	2.933	1.131	1.032

ASH CONSTITUENTS IN 100 PARTS OF DRY MATTER.

	1.	2.	3.	4.	5.	6.	7.	8.	9.
K ₂ O	1.068	1.161	1.501	0.370	0.321	0.935	0.269	0.501	0.162
Na ₂ O.....	0.573	0.516	0.307	0.110	0.112	0.171	0.081	0.150	0.237
CaO	1.781	1.812	1.967	0.771	0.801	2.062	1.639	1.061	0.969
MgO	0.678	0.132	0.517	0.360	0.620	0.181	0.365	0.316	0.273
Fe ₂ O ₃	0.078	0.205	0.035	0.157	0.068	0.069	0.122	0.081	0.078
Mn ₂ O ₃	0.102	0.036	0.035	0.771	0.213	0.106	0.121	0.180	0.161
P ₂ O ₅	0.356	0.512	0.398	0.197	0.080	0.163	0.189	0.159	0.207
SO ₂	0.366	0.906	0.026	0.116	0.096	0.207	0.197	0.136	0.169
SiO ₂	1.731	0.366	1.579	0.165	0.085	2.111	0.312	0.897	1.111
Cl	0.767	0.731	0.192	0.083	0.172	0.170	0.069	0.136	0.161

To compare these with one another, and with various straws, the analytical results were calculated on the mean percentage of water, 17.5 per cent., and from these figures the manurial value was obtained, by multiplying the amount of nitrogen by 5, phosphoric acid by 2, and potash by 1; manurial units are thus obtained of the value of 10 pfennigs (slightly more than one penny) each.

Leaves from—	Percentages calculated.			Manurial Units.	Value in Marks per Centner.
	N	P ₂ O ₅	K ₂ O		
1. Grey poplar (<i>Populus canescens</i>)	1.52	0.31	0.92	9.11	0.91
2. White willow (<i>Salix alba</i>)	2.21	0.11	1.25	13.20	1.32
3. Silver poplar (<i>P. argentea</i>)	1.65	0.33	1.26	10.20	1.02
4. Hornbeam (<i>Carpinus Betulus</i>)	1.09	0.16	0.31	5.60	0.56
5. Birch (<i>Betula alba</i>)	0.670	0.067	0.270	3.70	0.37
6. Sycamore (<i>Acer Pseudo-platanus</i>)	0.81	0.11	0.80	5.30	0.53
7. Alder (<i>Alnus glutinosa</i>)	2.17	0.15	0.22	12.90	1.29
8. Oak (<i>Quercus Robur</i>)	0.93	0.13	0.12	5.30	0.53
9. Beech (<i>Fagus sylvatica</i>)	0.87	0.17	0.39	5.10	0.51
Oat straw	—	—	—	—	0.50
Rye straw	—	—	—	—	0.35
Barley straw	—	—	—	—	0.15

Hence, the ashes of poplar and willow leaves contained 5 to 5.7 per cent. of valuable plant food; the ash from sycamore 4 per cent.; whilst the proportion of these constituents in the other ashes amounted to from 2 to 2.3 per

cent.; the first-mentioned leaves would therefore constitute an excellent fertiliser, even for a very impoverished soil. It is noteworthy that the beech-humus beneath the beech tree, resting on grey-sand formation, contained three times more nitrogen than the freshly-fallen leaves, whilst the mineral matter of the leaves was more than double that of the humus. Apparently, therefore, the dense

network of surface roots of the beech tree are especially adapted for utilising the mineral matter set free by the decomposition of the freshly-fallen leaves, thus leaving the soil richer in nitrogen.—D. A. L.

Peat as Manure. Dr. Schriener-Triesdorf. Süchs. Landw. Zeit. 1884, 429.

The author has for 10 years carried on experiments in wooden boxes sunk in the ground, each about 1 cub. metre capacity, filled with about 13 cwt. of red sandstone; half the boxes received an addition of 5% peat earth. With oats the results were:—

	PURE SAND.		SAND WITH 5% PEAT.	
	Seed.	Straw.	Seed.	Straw.
	grm.	grm.	grm.	grm.
Unmanured	8	27	71	170
Mineral Manure alone.....	11	53	91	277
Mineral Manure plus Nitrate of Soda	199	367	492	837
Mineral Manure plus Sulphate Ammonia	470	837	553	1073

The addition of peat yielded similar marked increase with barley, rye, buckwheat, peas, beans, potatoes, etc.—J. R.

Manuring Experiments with Precipitated Phosphate of Lime. Lössbecke-Marzhausen Landw. Zeit. u. Anz. 1884, 612.

In agreement with previous experiments on light soils these experiments in 1882-83, with barley on a clayey

loam, and oats on a light soil, containing lime and humus, show that precipitated phosphate of lime, associated with nitrate of soda, is far superior to the former alone, or a mixture of it with superphosphate.—J. R.

Influence of Light upon the Germination of Seeds. A. Cieslar. *Naturforscher*, 1884, 156.

THE results showed that a few seeds (*viscous album*) will not germinate without light; others (barley, etc.) germinate equally in darkness or light; some (*Poa memorialis*, etc.) were assisted by light. Yellow light assisted germination, violet hindered it, white light caused a marked improvement.—J. R.

Chemical Analysis of the Outer Wood and Heart Wood of Various Trees. Dr. W. Daube. *Forstliche Blätter*, 20, 177.

IN trees the constituents separate into several concentric layers, vitality is confined to the outer wood, the inner wood seeming to take no further part in it. A sharp characteristic difference between the outer and inner wood is, however, not yet known, but the author sought to establish one, and selected trees of the following ages,—larch, 103; fir, 104; pine, 75; oak, 125; beech, 180. The relative amounts of oxygen, nitrogen, carbon, hydrogen, and ash were determined without establishing any essential difference, save in the pine, where the heart-wood contained 54% of carbon against 50% in the outer, and 39% oxygen against 43%. The author thinks this is due to the larger amount of resin in the heart-wood. The various mineral constituents were then determined, and showed potash always most abundant in the outer wood, phosphoric acid decidedly so; lime various, also magnesia; ferric oxide the same, sulphuric acid larger in amount in the outer wood, silica and soda in but slight quantity.—J. R.

Dissolved Wool. Dr. Mäcker. *Magd. Zeit.* 1884, 121.

WOOL intimately intermixed with quicklime, and moistened with water, will, after 2 to 3 months, furnish a capital compost for autumn dressing. Wool can also be treated in lead-lined boxes, with sulphuric acid. This procedure, though denser, acts quickly, and there is no loss of ammonia.—J. R.

Upon the Assimilability of Phosphoric Acid contained in Stones and Soil. G. Lechmier. *Compt. Rend.* 98, 1058.

THE author has made experiments to show the direct assimilability of the phosphoric acid contained in stones freed from all organic matters.

The trial soils were composed partly of slate, partly of granite, the stones carefully washed, dried, powdered, and mixed, filled into flower-pots, and manured with a mineral manure composed of ammonium nitrate, calcium sulphate, and a potash salt, also one-half of the pots received phosphate, the other not; each pot was sown with five seeds of buckwheat, which together weighed 0.12-0.13 grm., and contained 0.0012 grm. phosphoric acid.

The table below gives the results:—

EMPLOYED.		Dry substance harvested.	Phosphoric acid harvested.
		Grm.	Grm.
Blue-grey compact slate, with 0.20% phosphoric acid..	without phosphoric acid	5.73	0.018
	with " "	21.85	0.237
Red slate, with 0.10% phosphoric acid.....	without " "	9.11	0.051
	with " "	12.36	0.513
Granite, with 0.10% phosphoric acid..	without " "	9.71	0.076
	with " "	31.20	0.208

The added phosphoric acid considerably increased the yield, but the plants were evidently able to take up an

important amount of phosphoric acid from the pure mineral.—J. R.

Comparative Trials with Peat Compost and Nitrate of Soda on Beet. Dr. L. Kuntze Spora. *Neue Zeits. f. Rübenzucker Ind.* 1884, 133.

BEETS from strontia-treated molasses were made into a compost by drying up with peat; the mixture, containing 2.5-3.3% nitrogen and 11.5-14% potash with good condition, was tried associated with Baker guano or superphosphate, against nitrate of soda with the same. With cereals no difference was produced. With beet good results were obtained in yield of roots and of sugar; and trials with various sorts of beet also showed that the compost with Baker guano gave a higher yield of crop and sugar than nitrate with Baker guano.—J. R.

The Absorption of Atmospheric Nitrogen by Plants. W. O. Atwater. *Amer. Chem. J.* 6, 365.

IN order to decide the question whether plants growing under normal conditions are able to absorb a considerable weight of free or combined nitrogen from the air, peas were grown in washed and ignited sand, moistened with solutions of nitrogenous and mineral matter of known strength. The concentration of the solution, the absolute quantity of solid matter, and the proportion of nitrogen with mineral matter was varied in different experiments. The plants grew outside in the air, but protected from dew and rain. The excess of nitrogen found in the plants at the end of the experiments over the quantity of nitrogen which was in the seed and the solutions, represents the quantity of nitrogen taken from the atmosphere. Different experiments yielded an excess of nitrogen, which rose in one case to 51%. The greatest excess was found, if the concentration of the solutions did not interfere with a good thriving of the plants, and provided the supply of mineral matter was more than sufficient. In such cases there was a gain of nitrogen amounting to 50%. The author does not state his opinion how uncombined nitrogen can be absorbed by the plant, but only refers to experiments made by Berthelot, which show that electricity of such a tension as prevails on the surface of the earth in the air surrounding the plant can cause the absorption of free nitrogen by means of dextrine and cellulose.—S. H.

XV.—SUGARS, GUMS, STARCHES, Etc.

Experiments with Various Sorts of Sugar Beets. Dr. G. Liebscher. *Bied. Centr.* 13, 774.

CARRIED out on deep loam, with 1 cwt. of superphosphate ploughed in in autumn, and 1 cwt. nitrate of soda in spring worked in by a cultivator. Average results according to yield of sugar placed the varieties as follows, the best being first: Kl Wanzlebener, Knauer's Elektor, Wendelsteiner, Dornburger, Knauer's Imperial, Vilmorin, Stoebnitzer, Denkendorfer.—J. R.

The Part played by Animal Charcoal in Sugar Factories, specially as regards the Silicate of Lime. H. Pellet and A. Galvalowski. *Bied. Centr.* 13, 711.

MANY factories have lately worked without animal charcoal, by careful special filtration; this in most cases has presented no difficulty, but in some the filters have soon been stopped up, and this according to the author is caused by the silica in the juice derived from the limestone employed, and specially from the coke used in burning the lime; for instance, a piece of original limestone contained 0.16 to 0.20 per cent. silica, and a piece of burnt lime 0½ per cent. A part of the silica dissolves in the juice, gradually separates during the evaporation, lining the pipes with a bad non-conductor, and the other part not so separated hinders the filtration. Examination of a three-kettle system gave 0.40 per cent. silicic acid in the deposits of the first, 23.40 per cent. silicic acid of the second, and 69.80 per cent. in deposits of the third. Juice thus containing silica, when filtered through charcoal, loses it, and on revivifying the charcoal used, the

latter is gradually made harder. The limestone should not be intermixed with the fuel, but be heated from the side.—J. R.

Preservation of Dried, Washed, Pressed Sugar-beet Sections. H. Hellriegel. Bied. Centr. 14, 93-98.

SEVERAL series of experiments were instituted to investigate the subject suggested in the title. Various samples of pressed sugar-beet sections were taken. Samples were prepared as follows:—(1) dried slowly at 50°; (2) dried slowly at 100°, but not quite free from water; (3) samples which had been slowly dried were heated strongly and dried to excess; (4) fresh samples dried at first partially, then completely in current of air; (5) fresh samples heated strongly and dried to excess; (6) not sufficiently dried, remaining soft and containing 20 per cent. of water. To compare with these samples of clover and meadow hay, pea straw, rape, and earth-nut meal, dried to a somewhat similar extent as the sugar-beet samples, were also experimented on. These samples were subjected to various varying conditions of temperature and moisture for different periods. From time to time observations were made as to the growth or non-growth of mildew, loss or gain in moisture, and of the proportions of dry matter. From which numerous observations, the author concludes that the sections are not remarkably hygroscopic, and, in fact, are less so than many of our ordinary feeding-stuffs, such as clover and meadow hay. The sections are also not very prone to decomposition, and did not become mildevery as readily as oilcake and hay. Moreover, after eight months' storing under most unfavourable circumstances, they suffered less loss in dry matter than rape and earth-nut meal, and clover and meadow hay.—D. A. L.

Growth of Sugar-beet. B. Corenwinder. Bied. Centr. 14, 113-115.

SUGAR-BEET were grown on a soil somewhat poor in phosphoric acid, plots were arranged without and with different manures. The application of 600kilos. ammonium sulphate per hectare increased the yield per hectare from 33,440kilos. to 51,750kilos. The same quantity of ammonium sulphate, with 400kilos. superphosphate, gave a yield of 55,400kilos., whilst sowing 200kilos. of magnesium sulphate, in addition to the above quantities of the other manures, yielded 54,900 kilos., showing that the magnesium salt was superfluous. The composition of the roots from all plots was about the same, and the author remarks that the plant evidently assimilates definite amounts of mineral constituents without reference to the supplies in the soil. Cultivations of sugar-beet were made in washed and ignited sand with (1) all the necessary constituents, and (2) with lime excluded. The yield of roots in the first case was more than double the yield in the second, although the weight of leaves was in the reverse order, whilst without lime the percentage of sugar in the roots was lower, but the ash per cent. was greater than with lime. It is of interest to note what a remarkable effect withholding this ingredient has on the growth of the plant in spite of the very small percentage of lime (0.037 to 0.04) contained in normally-grown roots. The author remarks that water-culture only gives trustworthy results with water plants, and that for other plants purified sand should be used as the cultivating medium.—D. A. L.

A Sugar and Betain from Cotton Cake. H. Ritthausen and Others. Bied. Centr. 14, 132-133.

THE sugar is obtained by extracting cotton cake with 80 to 85 per cent. alcohol. It crystallises in needles, reduces Fehling only after heating with acid, and its rotatory power is $\alpha_D = 104.5$. This sugar is identical with the plus-sugar obtained from molasses by the strontium hydroxide process, also with Bohm's "gossypose," and Loiseau's "raffinose." Tollens does not recognise its identity with Berthelot's melitose, and therefore suggests the retention of the name raffinose. A betain, hydroxyquinoline, is obtained from the

mother-liquor from the sugar by precipitation with platinic chloride. Bohm has obtained quinoline platinchloride, by precipitation, from cotton seed.

—D. A. L.

Composition of Starch-sugar Syrup, of Honey, and the Adulteration of the Latter. J. Sieben. Bied. Centr. 14, 134-137.

STARCH syrup, when fermented with yeast, yields less alcohol than pure dextrose, but more than corresponds to the dextrose present in the syrup, hence some other sugar must take part in the fermentation, even if only incompletely. The residue from pure dextrose, after fermentation, does not reduce Fehling's solution; but that from dextrose syrup reduces it strongly. From other determinations, the syrup is found to consist of: dextrose, 21.97 per cent.; maltose, 15.80; dextrin, 41.96; water, 20.10; ash, 0.30. The author has examined sixty samples of genuine honey. In very many cases saccharose was absent, in other cases it was present in small quantities, in some it reached four per cent. and in one eight per cent. Dextrose and levulose together compose about 68 to 78 per cent. of honey; the ratio they bear to one another, however, varies. The average composition of the sixty samples was:—Dextrose, 34.71 per cent.; levulose, 39.24; saccharose, 1.08; water, 19.98; non-saccharine matter, 5.02. The author heats the honey with hydrochloric acid, which destroys the levulose, with brown colouration, more readily than the dextrose, which can then be estimated alone. To detect adulteration of honey with starch syrup, the author proceeds as follows:—25grm. of honey are fermented for forty-eight hours with 12grm. of yeast free from starch and water, to make up 200cc.; aluminium hydroxide is then added, the solution made up to 250cc., and 200cc. of the filtrate are evaporated to 50cc. and examined in the polariscope. The presence of starch sugar will be indicated by dextro-rotation. When the residue from fermentation is heated with hydrochloric acid, the product should not reduce Fehling's solution, as honey contains no dextrin. The method mentioned above (heating with hydrochloric acid, etc.), and one wherein slight excess of Fehling's solution is used, and the filtrate examined after heating, are sometimes employed for detecting starch sugar in honey.—D. A. L.

On the Occurrence of Leucine and Tyrosine in Beetroot Molasses. E. O. von Lippmann. Ber. 17, 2835.

SOME time ago the author observed the occurrence in the molasses of a monobasic acid, $C_5H_7NO_3$, identical with Schützenberger's glutimic acid (*Ann. de Chim.* v. 16, 289) and probably with Hattinger's pyroglutaminic (*Wiener Monatshefte* 3, 228). The author concluded that the glutimic acid, as well as aspartic and other nitrogenous acids were formed by the action of alkalis on the albumen of the beetroot. It is true that the beetroot itself contains asparagine and glutamine, but other characteristic decomposition products of albumen are found in the molasses, and probably the greater part of the nitrogenous constituents consist of such compounds. The author now describes the separation and identification of leucine and tyrosine. A quantity of the ammoniacal alcoholic waste liquor from the calcium saccharate, which is frequently allowed to accumulate in works, was neutralised with sulphuric acid and allowed to stand, when a compact precipitate formed. The liquid was drawn off and evaporated to a small bulk. The residue was dissolved in hot water, neutralised with lead acetate, and filtered. The filtrate, after removal of excess of lead with sulphuretted hydrogen, was evaporated, and the thick residue thrown into strong alcohol. A gummy precipitate was formed, and was purified by repeated digestion with strong alcohol. It was found to consist chiefly of dextrin. The alcoholic solutions left a clear syrup on evaporation, which dissolved completely in hot water. Lead acetate was added until no further precipitate formed, and the filtrate was decolourised with animal charcoal. The syrup deposited crystals, which were removed. The mother-liquor was further concentrated, and after stand-

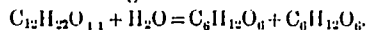
ing some weeks yielded a second crop of crystals. The first-formed crystals consisted of tyrosine, the second of a mixture of tyrosine and leucine, which were easily separated by alcohol. The two substances were identified by analysis, and by a careful study of their properties. The optical properties of the tyrosine and leucine were examined by Professor Landolt, and the identity of the compounds with those obtained from animal matters was established. Schulze and Bosshard obtained active tyrosine and leucine, the former levo-, the latter dextrorotatory, by decomposing conglutine, prepared from the seeds of the lupin, with hydrochloric acid, but inactive compounds by decomposing conglutine with barium hydrate; but the active substances were obtained from beetroot by the action of lime or caustic alkalis. The author has observed the same decomposition products of the albuminates in the etiolated shoots of the beetroot as in those of other plants growing in the dark. The shoots were crushed and pressed, and the liquid was boiled, filtered and precipitated with alcohol. The precipitate contained asparagine, and from the filtrate, asparagine, tyrosine, leucine, glutaminic acid and aspartic acid were isolated. A single observation showed that the tyrosine was dextrorotatory, so that there are two optically isomeric tyrosines.—S. Y.

Purification of Refuse Water from Sugar Factories. Dr. A. Bodenbender. Braunsch. Landw. Zeit. 52, 16.

THESE waters contain much suspended matter, nitrogenous and non-nitrogenous substances, also various salts, such as chlorides, phosphates, etc. Decomposition sets in readily. The author proposes to filter off the suspended matter, and then to treat the water with sulphate of alumina, magnesia, or protoxide of iron, or else ordinary superphosphate, afterwards adding lime to a weak alkaline reaction. The clear water can be run off, whilst the deposit yields a valuable manure. This treatment is good even for irrigation purposes, as the irrigation fields, not being overloaded with decomposing organic matter, will be effective much longer. Such water can be used for household purposes, or be with safety discharged into a small water course.—J. R.

Researches on Milk, Sugar, and Galactose. W. H. Kent and B. Tollens. Ann. 227, 221.

THE authors prepare mucic acid by heating 100grm. coarsely-powdered milk sugar with 1200cc. nitric acid of sp. gr. 1.15 in a porcelain basin on the water-bath, until the volume is reduced to 150 or 200cc., or until the liquid has become thick. After cooling, 200cc. of water are added, and after standing some days, the mucic acid is filtered and washed with 500cc. of water. The yield is about 40grm. Milk sugar is converted by dilute hydrochloric or sulphuric acid into galactose and dextrose:



The yield of mucic acid from 100grm. galactose, treated as above, is 77.4 per cent. When 10grm. of galactose are heated with 20cc. of hydrochloric acid of sp. gr. 1.12 to 100° for 5 hours, levulinic and formic acids are formed. By heating 3grm. of mucic acid with 10grm. of water to from 175 to 180° for 8 hours, it is decomposed, probably into dehydromucic acid, pyromucic and other bodies.—S. Y.

XVI.—BREWING, WINES, SPIRITS. Etc.

How Sulphur acts against the Oidium Fungoid. E. Machi and Portele. Die Weinlaube, 1881, 349.

RECENT experiments confirm the previous conclusions of J. Moritz, that sulphur acts by formation of sulphurous acid, which formation is much assisted by elevation of temperature.—J. R.

Comparison of Barleys of Various Countries. L. Marx. Zeits. f. d. Ges. Brauwesen, 1884, 375.

THE author has examined over 400 barleys of the last 6 harvests of various countries, for the protein com-

pounds and phosphoric acid. The proteids vary from 9.60% to 12.76%; the phosphoric acid from 0.913% to 1.911%; Russia and Baden being highest, England and Austria lowest. No connection was found between the amounts of proteids and phosphoric acid; these both vary much, and whether a barley be rich in them can only be determined chemically, as a country will produce barley at one time rich and at another time poor in these constituents.—J. R.

Production of Maltose. L. Guisnier. Chem. Centr. 15, 413.

DISTILLED water is best. Water containing calcium bicarbonate or gypsum must be freed from these; a water extract from green malt should be used. Directions are given for dissolving up the starch by use of water, malt extract, stirring and regulated temperature. Finally, the syrup is to be filtered and concentrated.—J. R.

Plastering Wine. J. Erdélyi. Die Weinlaube, 1884, 340.

AN experiment to show whether the colour and keeping power of wine is increased by plastering. The result was negative, and in author's opinion even injurious.—J. R.

The Influence of Grape Stones upon the Tannin of Red Wine. Dr. J. Nessler. Bied. Centr. 13, 862.

RESULTS show that the skins which rise to the top, and the stones which fall to the bottom, should both be thoroughly stirred up in the wine some three or four times daily.—J. R.

Correction of Acidities in Wine. Dr. P. Wagner and Dr. F. Becker. Bied. Centr. 13, 862.

NUMEROUS experiments show that the addition of alcohol, neutral tartrate of potash, potassium carbonate or bicarbonate, powdered marble, chalk, or oyster shells, are, for various reasons, injurious, but chemically pure calcium carbonate may be used in proportion to the amount of free tartaric acid present.—J. R.

Contributions to the Chemistry of Malting and Manufacture of Spirits. Prof. Behrend, of Hohenheim. Bied. Centr. 14, 51.

THE first part of this paper treats of the extraction of inorganic and organic matter by the "steeping water." Three kinds of barley were experimented on—Saxon, Bohemian, and Hungarian, and 1000 dried grains of each of these contained respectively 40.22, 35.82, and 33.44 grams. In the experiments ten litres of water were poured on 10 kilograms of barley contained in a suitable conical tin vessel provided with an outlet for water at the lower end. After 14 hours the first "steeping water" was run off and measured. The deficiency from 10 litres represented the quantity of water retained by the grains. It seems that the small grains retain slightly more water than the larger kinds. A second 10 litres of water were then added, and replaced after 24 hours by a third 10 litres. The third "steeping water" likewise remained 24 hours in contact with the barley, which was then fully steeped. Aliquot volumes of the three steeping waters were evaporated, dried at 110° to 115° C., weighed, burnt, and again weighed. The weights thus obtained gave total solids, and the inorganic and organic matter extracted. The water employed was exceptionally hard, and contained per litre 0.056grm. organic, and 0.354grm. inorganic matter. The results are tabulated in the original; they indicate that the first "steeping water" extracts the largest quantity of solid matter from the barley, whilst the third extracts the least, but nevertheless a considerable quantity. They, moreover, show that the first two "waters" extract more inorganic than organic matter, whereas the third "water" contains more organic than inorganic matter, and the total combined waters about equal amounts of each. And another point of special interest to the brewer is evident from these results—namely, that the smaller

grains yield more to the water than the large ones do, no matter from what standpoint the case is viewed; thus Saxon barley gives up 0.55 per cent. of its dry matter, Bohemian 0.63, Hungarian 0.79. The author gives a full explanation of these phenomena, attributing all to osmotic action. Owing to the large removal of nutritious matter by the "steeping water," prolonged steeping, especially in the case of small grain, should be avoided in practice.

In the second part of this paper the changes produced by germination in the nitrogenous matter of barley are investigated. In these experiments the Saxon and Hungarian barley, mentioned above, were employed. A preliminary experiment showed that the conversion of insoluble into soluble nitrogenous matter takes place very rapidly. In other experiments the grain was steeped for 36 hours, using two successive lots of water. It was then spread in layers about 2cm. deep to germinate. At various periodical stages carefully selected samples were taken, and total nitrogen, nitrogen soluble in water, and non-albumenoid nitrogen determined in them. All nitrogen determinations were made by Kjeldahl's method, which was found very satisfactory. The non-albumenoid solution was prepared by boiling the aqueous extract with ferric acetate, and filtering off the precipitated albumen. The results are tabulated below:—

CHANGES PRODUCED IN THE NITROGENOUS MATTER BY GERMINATION OF SAXON (LARGE-GRAIN) BARLEY.

STAGE.	PERIOD OF GERMINATION.	100 BARLEY GRAINS CONTAIN		PER CENT. NITROGEN IN THE DRY MATTER.					
		Grams. Dry Matter.	M.grams. Nitrogen.	Total.	Soluble in Water.	Non-albumenoid	ALBUMENOID.		
							Soluble.	Insoluble.	Total.
I.	Original Barley....	4.025	71.0	1.838	0.332	0.178	0.151	1.506	1.660
II.	Fully steeped.....	3.871	70.1	1.811	0.212	0.167	0.015	1.599	1.614
III.	After 22 hours.....	3.811	69.2	1.811	0.217	0.159	0.056	1.599	1.655
IV.	After 62 hours.....	3.805	69.6	1.828	0.381	0.298	0.083	1.177	1.530
V.	After 86 hours.....	3.632	70.1	1.931	0.151	0.317	0.101	1.180	1.584
VI.	After 131 hours....	3.130	69.8	2.035	1.015	0.189	0.556	0.990	1.516

Stage III., the root sprouts had appeared; stage IV., root sprouts were as long as the barley grain, stock sprout $\frac{3}{4}$ that length; stage V., root sprouts were $\frac{1}{2}$ and stock sprouts $\frac{3}{4}$ the length of the barley grain; stage VI., was "slightly over-grown malt," with most root sprouts twice as long as a barley grain, some stock sprouts beginning to shoot.

made both before and after the experiments, with the results tabulated on p. 414, per 100 of dry matter.

The soluble nitrogenous matter was increased in all cases by the heating, especially with lupines and peas; but, whereas with the former the increase in the non-albumenoid nitrogen is greater than the increase in the amount of soluble albumen, with the latter the reverse is

CHANGES PRODUCED IN THE NITROGENOUS MATTER BY GERMINATION OF HUNGARIAN (SMALL-GRAIN) BARLEY.

STAGE.	PERIOD OF GERMINATION.	100 BARLEY GRAINS CONTAIN		PER CENT. NITROGEN IN THE DRY MATTER.					
		Grams. Dry Matter.	M.grams. Nitrogen.	Total.	Soluble in Water.	Non-albumenoid	ALBUMENOID.		
							Soluble.	Insoluble.	Total.
I.	Original Barley....	3.311	76.0	2.20	0.30	0.12	0.18	1.09	2.17
II.	Fully steeped.....	3.319	71.0	2.23	0.21	0.12	0.12	1.09	2.11
III.	41 hours	3.153	71.1	2.30	0.10	0.18	0.22	1.06	2.18
IV.	89 hours	3.115	71.5	2.37	0.70	0.13	0.30	1.58	1.91
V.	113 hours	3.021	71.6	2.17	0.87	0.51	0.30	1.60	1.90
VI.	137 hours	2.920	71.2	2.56	0.92	0.61	0.31	1.62	1.93
VII.	185 hours	—	—	2.65	1.08	0.67	0.11	1.57	1.98
VIII.	209 hours	—	—	2.68	1.11	0.71	0.37	1.57	1.94

Stages I., II., and III. were similar to those with the Saxon barley; as malt, stage IV. was "not ready"; the case, and the solution exceeds the decomposition of the albumenoids. Maize and dari are likewise affected to

a considerable extent, but not so much as the leguminous seeds; the potatoes had been dried at 110°, therefore, the albumen had been rendered insoluble, a state of things which was not much improved by the heating under pressure. The staleness or freshness of the potatoes does not appear to affect the results to any considerable extent. The results indicate that the albumenoid matter of the above materials is both dissolved and decomposed by steaming under pressure; moreover, the albumenoid matter in the different materials is not affected to the same extent. With regard to the solution, the solution of albumen precedes decomposition, a fact confirmed by other experiments, when steaming under pressure for a short time dissolved albumen; whereas, continuing the heating converted the albumen into amides. To test the

Valuing 1 kilo. of fat and albumenoids at 32·5 pfennigs, and 1 kilo. of non-nitrogenous nutritive matter at 6·5 pfennigs, the three would have the respective values, 9·88, 9·37, and 9·22 marks per 100 kilos.—D. A. L.

Improvements in the Mode of and Apparatus for Cleansing Beer. A. G. Southby, Jersey. Eng. Pat. 764, January 5, 1884.

THIS relates to improvements in the mode of and apparatus for cleansing beer, either in the fermenting vat or in casks and pontoons. In the first case the pulpy yeast is pumped from the surface of the beer, and by a force pump forced into filter bags or yeast presses, the liquid beer which drains away from these being either returned directly

CHANGES PRODUCED IN ALBUMENOIDS BY STEAMING UNDER PRESSURE.

MATERIAL	Total Nitrogen	BEFORE HEATING UNDER PRESSURE.					AFTER HEATING UNDER PRESSURE.				
		NITROGEN.		ALBUMENOID NITROGEN.			NITROGEN.		ALBUMENOID NITROGEN.		
		Soluble.	Non-Albu- menoid.	Soluble.	In- soluble.	Total.	Soluble.	Non-Albu- menoid.	Soluble.	In- soluble.	Total.
Lupin	8·51	3·03	0·67	2·36	5·18	7·84	6·23	2·60	3·51	2·28	5·82
Pea	1·26	1·19	0·15	1·01	2·77	3·81	3·71	1·11	2·60	0·52	3·12
Maize	2·03	0·32	0·20	0·12	1·76	1·88	0·80	0·55	0·25	1·28	1·53
Dari (<i>sorghum tataricum</i>)..	1·10	0·15	0·13	0·02	1·25	1·27	0·61	0·13	0·21	0·76	0·97
Old Potatoes*	1·23	0·72	0·17	0·25	0·57	0·76	0·86	0·56	0·30	0·37	0·67
New Potatoes†	1·13	0·76	0·58	0·18	0·67	0·85	1·02	0·60	0·12	0·11	0·83

* A year after harvesting.

† Freshly harvested.

effect of bulk of material, some experiments were conducted on a manufacturing scale; maize and dari were gradually heated in a Henze's pressure boiler, until pressure of steam indicated four atmospheres. The changes in the albumenoids were similar to those in the smaller experiments, but not so marked, owing to the shorter duration of the experiment—just over two hours. In practice it is, therefore, advisable not to prolong the period of heating with superheated steam, for the decomposition of the albumenoids, as well as fats, reduces the value of the spent product for cattle feeding; the yeast, however, thrives better with amides than with albumenoids as nitrogenous food.—D. A. L.

Action of Sulphur on Wine, and Means for removing and keeping away Acetic and other Fungoids. J. Nessler. Bied. Centr. 14, 135, 132.

WHEN flowers of sulphur are sprinkled over the fungoid termed *kühnen*, on the surface of wine their development is stopped or retarded, but at the same time hydrogen sulphide is evolved, which gives a bad odour to the wine. The same gas is evolved when free sulphur is present in most or fermenting wine. The author recommends the use of sulphurous acid, which is efficient for destroying and keeping away the fungi, and is not accompanied by the disagreeable hydrogen sulphide. The author has a patent apparatus for the application of the sulphurous anhydride, which can also be used for its liquefaction.—D. A. L.

Feeding Value of Brewers' Grains. J. König. Bied. Centr. 14, 141.

THREE samples of brewers' grains had the following composition per cent:—

	I.	II.	III.
Water.....	21·61...	6·26...	9·66
Albumenoids.....	21·19...	21·69...	19·60
Fat	6·76...	8·06...	9·73
Non-nitrogenous extractive matter.....	33·86...	44·32...	39·35
Woody fibre	17·12...	15·00...	17·62
Ash.....	8·40...	4·67...	4·04

to the vat or otherwise utilised. The suction pipe may be connected with the pipe leading from a parachute, or may dip down to the lowest part of a vessel suspended at the surface of the beer, the yeast being swept in by means of a revolving radial skimmer. When the beer is cleansed in casks or pontoons, the yeast trough or shoot or stillion into which the yeast falls from the casks, is made with a bottom sloping sufficiently for the yeast to run down into a well, from which it is pumped and forced into filter bags or yeast presses. The beer draining from these is returned to the cleansing casks.—W. D. B.

Improvements in Treating Grain for Brewing and Analogous Purposes, and in Apparatus therefor. E. R. Southby, London. Eng. Pat. 1269, January 11, 1884.

THE object of this invention is to prepare grain otherwise than by malting, that it may be ground up and mashed with malt as if malt alone were being worked. The treatment is advantageously applicable only to those grains—viz., barley, wheat, rye, and oats—the starch of which can without previous cooking be converted by the action of malt into sugar and dextrin. The grain, sufficiently moist to render the corns tough, is passed between rolls until the corns are flattened out and their structure disintegrated, without, however, their being reduced to powder. The crushed grain is kiln-dried at a temperature not exceeding 100°, until sufficiently desiccated to grind easily when passed through the malt rolls. The above processes are carried out by means of roller-mill and kiln described.—W. D. B.

Improvements in the Treatment of Malt and other Grain. A. Schnell Lochbach Burgdorf, Switzerland. Eng. Pat. 7081, May 20, 1884.

THE object of this patent is the saving of time in the processes of steeping, germination, and drying in the manufacture of malt, and the mechanical appliances for carrying this into effect. A wheel or cylinder, the rim of which is provided with a number of cells, the sides of

which are perforated, revolves slowly, running on rollers. The grain to be malted is dropped into the cells from above, and a lid prevents the grain from dropping out during the rotation of the cylinder. The lower part of the apparatus dips into water so that the grain becomes moistened, and as the apparatus revolves slowly during its passage through the air germination takes place. The grain is finally dropped into a truck running into the interior of the cylinder by opening a door on the inside of the cell. The same apparatus may be used for drying the malt by passing a current of hot air through it during motion, and after the steeping tank has been drained off. The patentee claims (1) the arrangement as described for malted grain; (2) the arrangement as described for drying the grain after the operation of malting; (3) the application of the apparatus for soaking, husking, washing, drying, and torrefying other grain besides malt.—C. C. H.

Improvements in the Treatment of Alcoholic Spirits.
R. R. Tatlock, Glasgow. Eng. Pat. 8851, June 11, 1884.

To remove the harsh smell and taste particularly peculiar to new spirits, the patentee proposes to add thereto a small quantity of caustic soda, potash, or ammonia, and to neutralise the alkalis by a little acetic acid. The presence of the acid prevents the spirit from becoming yellow or discoloured. The alkali may be previously added to a small quantity of the spirit, or to the bulk without such previous admixture. Any salt having an alkaline reaction will serve the purpose, and any ordinary acid may be used in the place of the acetic acid, though not with the same advantage. The patentee claims (1) the process of treatment by means of caustic alkali; (2) the treatment by caustic alkali succeeded by the addition of an acid.—C. C. H.

XVII.—PRESERVING FOOD, MEATS, Etc.

Improvements in the Manufacture or Treatment of Cocoa.
W. L. Wise, London. From P. Lobeck, Germany.
Eng. Pat. 8625, June 5, 1884.

THE cocoa beans, either raw, roasted, shelled, ground, or otherwise prepared, are subjected for about thirty minutes to a temperature of 150° Centigrade and a pressure of from 5 to 6 atmospheres. The operation is effected in closed vessels, which may be of copper lined on the inside. The following changes take place:—Firstly, the albumenoids present in the bean are converted into products soluble in water; and, secondly, the starch is changed into soluble dextrine and glucose. This conversion into soluble products probably extends to other constituents of the cocoa, which is thus rendered easily digestible, and capable of being made into a beverage ready for the table, by the simple addition of boiling water or milk. The inventor claims as the advantages of this method of treating the bean, that no alkaline carbonates are added (as is frequently the practice, with the view of rendering cocoa soluble), and that the aroma and taste peculiar to cocoa are exhibited in their greatest intensity and purity.—E. G. C.

Method of Preserving Meat. Cecil Russell, Tooting.
From A. Losusso, Calcutta. Eng. Pat. 1534, February 4, 1885.

JOINTS of meat, or whole carcases, as the case may be, are placed in casks, or tanks, and covered with a cold, strong aqueous infusion of Mocha coffee. The vessels are then closed, and the meat is ready for storage or transport; thus preserved it will keep fresh for months, and when required for use it is removed from the casks or tanks and washed in cold water. One ounce of Mocha coffee may be allowed for each pint of water. This invention also applies to the preservation of game, fish, and other perishable articles of food.—E. G. C.

XVIII.—SANITARY CHEMISTRY, DISINFECTANTS.

Process and Apparatus for Deodorising the Fumes of Cement and other Kilns. E. and A. Asby, Southampton and Grantham. Eng. Pat. 8212, May 26, 1884.

THE contents of the kiln are first raised to a moderate heat, sufficient to drive off organic matter, accompanied by a small proportion only of carbonic anhydride. These fumes are passed through a retort or furnace chamber, containing coke or other fuel kept in a state of incandescence by an adequate supply of burning fuel. The fumes in passing through the incandescent fuel have their carbonic anhydride converted into carbonic oxide, which is burnt, with the other ingredients of the vapours or fumes. The hot gaseous products from the furnace chamber, and those direct from the kiln, may be conducted, on their way to the chimney or other exhausting apparatus, under suitable floors, so that the heat can be partly utilised for drying the slurry or other matter placed thereon, preparatory to its being treated in the kiln.—E. G. C.

Hygienic or Sanitary Concrete for Paving and other Purposes. J. Tottrell, Dublin. Eng. Pat. 8317, May 28, 1884.

POWERFUL disinfectants, such as carbolic acid, carbolates, sulphites, sulphates, bleaching powder, or other purifying, oxidising, and antiseptic substances, are mixed, either in a solid or liquid form, with the ordinary cements employed in paving roadways, and for floors, basements, foundations, walls, and the like.—E. G. C.

An Improved Disinfectant. J. Y. Johnson, London.
From E. O. Beck, Paris. Eng. Pat. 14,864, November 14, 1884.

AIR or oxygen is caused, by suitable means, to pass through a liquid composed of water and spirit or essence of turpentine, in the proportion of, say, nine parts of the former to one of the latter. The liquid is maintained during the operation at the ordinary atmospheric temperature, and when sufficiently saturated with ozone, it can be used as a disinfectant, for washing wounds or sores, etc., etc.—E. G. C.

XIX.—PAPER, PASTEBOARD, Etc.

Improvements in the Method of and in Boilers or Apparatus for treating Wood Pulp and other Vegetable Fibre. David Otto, Sweden. Eng. Pat. 11,651, August 26, 1884.

THIS invention relates to the treatment of wood or other vegetable fibre with solvent—for instance, solution of bisulphite—in boilers for the production of pulp, and consists, firstly, in the application of direct steam to the mixture of fibre and solvent, instead of heating the same by steam pipes; and, secondly, to an improved construction of cylindrical boiler with rounded ends rotating around its greater axis. The outer shell of the boiler is of steel, made in several distinct sections joined together by means of strong enclosing rings of sufficient width to lap far enough upon the two adjacent sections to be firmly secured to these by riveting, brazing, or welding. The inner shell is of lead—which need not be specially pure—about a quarter of an inch in thickness, applied in distinct lengths or sections joined when *in situ* by autogenous soldering. The lining thus formed is quite independent of the steel shell, and is prevented from crushing together by its own weight by means of internal lead-covered bracing, rings made of brass or some other metal having a higher co-efficient of dilatation by heat than iron. Between the lead and steel there is a narrow space; thus the lead can expand and contract without injury; the steel shell affords the requisite strength to the whole structure, the lead alone coming in contact with the contents of the boiler. As air remains in the space between the lead and the steel, and might, at high temperatures, expand sufficiently to crack the lead, a large number of orifices provided with stop-cocks, are made in the steel to serve the double purpose of per-

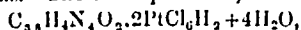
mitting egress of air and of pointing out the locality of minute cracks in the lead lining, which, if not looked to at once, would give the solution an opportunity to penetrate to the steel, and cause no small damage. Any escape of steam or solution from an orifice indicates damage to the lead in that locality. A sampling cock, of which the surfaces exposed to the solution are of lead, is fitted in a convenient position. Steam is directly introduced by pipes at each end, freely perforated. The extent of highly-heated surface is thus very small, and the inventor considers that it is this which enables him to produce a pulp, by the acid sulphite treatment, containing not more than one per cent. of calcium sulphate, whilst pulp from other boilers contains as much as 10-12 per cent. The solution of bisulphite best of 4.5° or 5° B. with the disintegrated material should not occupy more than two-thirds of the boiler space in starting, as the condensation of steam is considerable. The temperature should not exceed about 150° C., each charge being kept in the boiler rotating slowly for 10 or 15 hours.

—W. D. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Dicinchonine. O. Hesse. Ann. **227**, 153.

THE chief source of this alkaloid is the bark of cinchona, rosulenta and cinchona succirubra, especially the former, which contains cinchonidine, homocinchonidine, cinchonine, traces of quinamine and conquinamine, and 0.2 to 0.3 per cent. of dicinchonine. The two first alkaloids are precipitated from a neutral solution of the sulphates by means of Rochelle salt; the solution is then saturated with ammonia and shaken with small quantities of ether, whereby cinchonine is for the most part separated. The alkaloids from the ethereal solution are dissolved in dilute acetic acid, and after neutralisation are subjected to fractional precipitation with potassium sulphocyanide. Dicinchonine sulphocyanide is precipitated, but the first and third fractions contain other bases. The salt is mixed with caustic soda and extracted with ether, the extract is washed with water and evaporated, and the residue is dissolved in alcohol and saturated with hydrochloric acid; dicinchonine hydrochloride crystallises from this solution on evaporation. The base is less easily obtained from quinoidine and from cinchona succirubra. The free base, which has the formula $C_{20}H_{24}N_4O_2$, dissolves easily in ether, acetone, alcohol, chloroform and benzene, less easily in water and petroleum-spirit; it is insoluble in caustic soda. Its alcoholic solution is alkaline, and has a bitter taste. It has the rotatory power $(\alpha)_D = +65.6^\circ$. The hydrochloride, $C_{20}H_{24}N_4O_2 \cdot 2HCl$, forms easily soluble prisms. The chlorophosphate,



occurs in orange flakes; the hydriodide forms compact crystals, readily soluble in water, but insoluble in saturated solutions of common salt or potassium iodide; the sulphocyanide is amorphous; the neutral oxalate is obtained in compact, easily-soluble prisms, when an ethereal solution of oxalic acid is added to an ethereal solution of the base. When heated to 140° to 160° for six hours with concentrated hydrochloric acid, and probably, also, with sulphuric acid diapiocinchonine is formed.—S. Y.

Note on Brucine. A. Hanssen. Ber. **17**, 2849.

BRUCINE was boiled with chromic acid and dilute sulphuric acid. The liquid was poured into hot baryta water, filtered at once, and after removal of the excess of barium with carbon dioxide, the filtrate was evaporated. The acid was set free by dilute sulphuric acid, filtered and evaporated. It solidified to a glassy mass, insoluble in alcohol, chloroform and benzene. It contained no brucine. It was converted into the platinum double chloride, which formed gold-yellow scales. The composition was found by analysis to be $C_{16}H_{20}N_2O_4 \cdot 4.5H_2O$. A crystalline platinum double salt was also prepared from the product formed by the action of phosphoric chloride on brucine.—S. Y.

The Efficient Matter in Senna-leaves. R. Stockmann. Pharm. J. **3**, 749.

THE author repeated Kuby's experiments, thinking that the cathartine acid, $C_{15}H_{20}O_{12}N_2S$, discovered by the latter in senna-leaves, may represent rather a mixture than a uniform body. On preparing the acid, heating the extract or treating it with sulphuretted hydrogen was avoided. After purification, an acid was obtained which contained no trace of nitrogen or sulphur. If the solution of the acid be heated for a few minutes with a dilute mineral acid, it becomes turbid, depositing a brown amorphous precipitate, which has all the properties stated by Kuby for his cathartine acid. But this matter is not of a uniform composition; it can be subdivided by extraction with ether. The filtrate from the brown precipitate contains a sugary matter, which reduces Fehling's solution, but is not able to ferment. Stockmann thinks that cathartine acid belongs to that class of glucosides which can be decomposed by acids into sugar, and a whole series of other products.—S. H.

Quinine Sulphate of Commerce, its Composition and Analysis. W. F. Koppeschaar. Pharm. J. **3**, 809.

QUININE sulphate of commerce contains, besides other alkaloids, nearly always cinchonidine, which cannot be removed by recrystallising. The best method to determine the percentage of quinine and cinchonidine is that recommended by Oudemans—viz., the precipitation of the sulphate solution with sodium tartrate, and after weighing, the polarisation of the tartrates, which contain nothing but quinine and cinchonidine. Whereas the angle of rotation of quinine tartrate is $(\alpha)_D = -215.8^\circ$, that of cinchonidine tartrate is $(\alpha)_D = -131.3^\circ$. The author thinks that the commercial quinine sulphate contains, besides quinine sulphate, a double compound of quinine and cinchonidine sulphate.—S. H.

A New Apparatus for the Preparation of Solid Carbonic Acid. B. Cuillet. Jour. de Phys. **4**, 122.

THE apparatus, which is recommended to replace Thilorier's metal box, is constructed by Dueretet, and consists of an ebonite cylinder, through the lid of which a thin tube conveys liquid carbonic acid up to near the bottom. The carbonic acid which is not condensed escapes through a tube fastened in the bottom, and projecting in the interior of the cylinder for more than half its height. It is preferable to cool the liquid carbonic acid by refrigerating means before allowing it to enter the cylinder.—S. H.

Process for the Preparation of Thallin. Dingl. Polyt. J. **256**, 192.

FOR the preparation of tetrahydroparaquinanisol, named "Thallin," on account of the fine green colour which this base and its salts develop when treated with oxidising agents, the Badische Anilin- und Soda-Fabrik (Ger. Pat. 30,426, June 18, 1884) proceed as under:—4 kilos. of granulated zinc, 15 kilos. of hydrochloric acid of 1.14 sp. gr., and 1 kilo. of paraquinanisol hydrochloride are allowed to digest upon the water-bath for from eight to ten hours. The reaction is known to be complete when the zinc double salt of the new base, which is soluble with difficulty, begins to separate out. The zinc double salt is purified by recrystallisation from hot water, and the free base obtained therefrom by decomposition with an alkali. Thallin separates in the form of an oil, which solidifies on cooling to a hard, slightly yellow crystalline mass. Thallin is difficultly soluble in cold water, easily soluble in alcohol, ether, petroleum ether, and hot water. It melts at 42-43°, and boils at 282-283° (uncorrected). With organic and inorganic acids it combines to form salts soluble in water, of characteristic properties and crystallising well.—W. D. B.

An Improved Method of Manufacturing Carbonic Acid under any Desired Pressure. F. Raken. From H. Beins and J. F. Beins, Gröningen. Eng. Pat. 4175, April 2, 1885.

BICARBONATE or sesquicarbonate of soda is mixed with ammonium or potassium alum, and water added. By

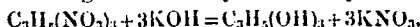
regulating the amount of this mixture by the capacity of the vessel to receive the carbonic acid liberated, the latter may be obtained under any desired pressure.

—W. D. B.

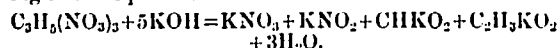
XXI.—EXPLOSIVES, MATCHES, Etc.

On Nitroglycerine. Mathew Hay. Monit. Scient. 15, 424.

THE best proportions for preparing nitroglycerine are 10 parts of glycerine, 30 parts of fuming nitric acid, and 60 parts of strong sulphuric acid, which gives a yield of 234 per cent. on the glycerine. When pure it is a colourless oil, which is not decomposed on heating to 100° C.; 1 grm. dissolves in about 800cc. of water, or 4cc. of absolute alcohol. By caustic potash it is not decomposed according to the usually assumed equation:



but, on the contrary, the glycerine at the moment of its formation is oxidised by the nitrate with production of acetic, formic, and nitrous acids, approximately according to the equation:



Other alkalis act in a similar manner.—A. G. G.

Improvements in Explosive Cartridges for Blasting and other Purposes. G. G. M. Hardingham. From Thomas Woolhouse, Paris. Eng. Pat. 2143, January 25, 1884.

"THIS invention consists of an improved manufacture of cartridges for blasting, mining, and similar purposes, the same being in certain forms adapted for use with ordnance and other firearms. The principle embodied is further applicable to shells, military mines, and other appliances of a like explosive character." A glass vessel containing liquid ammonia is introduced into the interior of a cartridge of dynamite, gunpowder, or other explosive; by the shattering of this vessel at the moment of explosion the ammonia is volatilised, and has the twofold effect of quenching the flame and increasing the effective force. Liquid carbonic acid or other volatile non-inflammable liquid may be substituted for the ammonia. Or an inflammable liquid, as ether, alcohol, or benzoline may be employed. In place of glass, the containing vessel may be made of caoutchouc. Or the explosive may be mixed or saturated with the liquid; thus gun-cotton or tonite may be saturated with ammonia and alcohol. Or the containing vessel may be annular, the explosive being placed within the centre. In cases where it is desirable to dispense with the use of cartridges, the bore hole may be filled with loose powder, with vessels containing the liquid interspersed.—W. D. B.

Improvements in Fuses for Shell Projectiles. Thersten Nordenfelt. Eng. Pat. 3235, February 13, 1884.

MECHANICAL improvements, with the object of securing increased safety during carriage over rough roads, etc., and increased stability and efficiency.—W. D. B.

Improvements in Explosive Compounds. Henry Edward Newton. From Alfred Nobel. Eng. Pat. 5382, 1884.

WITH the object of diminishing the liability to explosion by concussion attendant upon their employment, nitro-cellulose, nitro-mannite, nitrated starch, pierates, and other analogous fibrous or pulverulent substances are moistened with a combustible liquid, in which a nitrate or other oxidising agent has been absorbed in quantity sufficient to ensure perfect combustion. Solid combustible material, such as paraffin, stearine, and naphthalene applied in the melted state, may also be employed. Preference is given to the use of glycerine, since when heated it possesses considerable solvent power for various nitrates; the nitro-cellulose or other explosive is saturated with a mixture of glycerine, and the nitrate heated to the lowest temperature requisite for complete

solution of the nitrate, and the whole allowed to cool, after which the explosive is ready for use. A good shell composition is stated to be yielded by mixing 1 part of gun-cotton with 2 parts of a solution consisting of equal weights of glycerine, zinc nitrate and cupric nitrate.

—W. D. B.

Improvements in Machinery to be employed in the Manufacture of Lucifer Matches. Thomas Allen, of Reading. Eng. Pat. 5507, March 26, 1884.

THIS invention consists in an automatic mechanism for the purpose of placing the splints between the laths of the dipping frame, the filling of the dipping frame having hitherto been effected by hand apparatus.—W. D. B.

Improvements in the Manufacture of Gunpowder and other Explosive Compounds by the use of an Improved Material in the said Manufacture. T. Nordenfelt and V. A. Meurling. Eng. Pat. 6515, April 18, 1884.

COTTON or other similar fibre is rendered friable by being subjected to the action of hydrochloric acid, either in the state of gas or in solution, then pulverised and employed in place of the charcoal in gunpowder, or carbonised and the resulting charcoal employed for powder manufacture. Cotton reduced to powder by this means may also be employed in the preparation of gun-cotton.—W. D. B.

Improvements in the Manufacture of Powder for Blasting and other analogous Purposes. Camille Espir. Eng. Pat. 6548, 1884.

THE inventor claims the manufacture of a powder for blasting purposes, composed of 66 per cent. of unrefined nitrate of soda; 12 per cent. of refined and triturated sulphur; 22 per cent. of fine sawdust from hard wood. If the compound be intended for artillery purposes, 10 per cent. of charcoal is added. For certain purposes the following composition is adopted:—66 per cent. of unrefined nitrate of soda; 8 per cent. of refined and triturated sulphur; 21 per cent. of fine sawdust from hard wood; 5 per cent. of charcoal. The sulphur and sawdust are amalgamated by sieving, a solution in boiling water of the sodium nitrate poured upon the mixture, the whole well kneaded and dried by aid of steam.—W. D. B.

Improvements in Detonating Signals for use on Railways and in Apparatus to be employed therewith. E. D. Pass. From C. Liraud and E. Gaupillat, both of Paris. Eng. Pat. 7299, May 6, 1884.

THE improvements are confined to the mechanical construction and arrangement.—W. D. B.

Improvements in the Manufacture of Explosives. W. A. Barlow. From Adrien Gascou, of Paris. Eng. Pat. 9096, June 17, 1884.

IN carrying this invention into effect, 69 parts of powdered nitrate of potash are intimately mixed with 19 parts of flowers of sulphur, and 12 parts of ashes, rich in soda or potash, preferably obtained by burning dead leaves. One fifth part of tannin dissolved in 8 parts of water is introduced into the mixture, and the whole allowed to dry. The tannin solution is preferably obtained by making a decoction from chestnut, mangrove or oakwood.—W. D. B.

Improvements in Machines for the Manufacture of Matches. Sydney Pitt. From J. H. Mitchell, of Philadelphia, U.S.A. Eng. Pat. 11,686, August 27, 1884.

THE object of this invention is to provide a means for the continuous manufacture of matches, the splints being passed in the machine by a hopper, and the matches finally deposited in drying trays at the other end of the apparatus. By a picking-up mechanism, the splints, of length sufficient for two matches as usual, are delivered from a hopper, into which they are in the first instance

fed, on to an endless band which carries them forward through the machine for a short distance, when their upper surfaces meet a second endless band. The splints are carried between the surfaces of the two bands from this point until just before their final discharge from the machine. By suitable tightening rollers the tension of the belts is so adjusted that they hold the splints securely between them. Before sulphuring, the ends of the splints are warmed by means of steam-heating channels, curved to conform to the travel of the belt, on either side of the machine. The sulphuring is effected by causing the ends of the splints to pass between two asbestos-covered rolls, in contact with one another, suspended freely so as to allow the passage of the splints between them. The lower roll revolves in a pan containing sulphur, the rotation being effected simply by the passage of the splints. The heading apparatus consists of a closed receptacle, containing the composition and a rotating spiral, by means of which the composition is discharged regularly upon a plate which is moved to and from the ends of the splints during their passage over it; this arrangement is adopted to imitate the operation of vertical hand-dipping, and to obtain an equal distribution of the heading composition. The main part of the heading apparatus can be readily detached should the composition take fire. On passing from the heading apparatus, the duplex band is made to take a rapidly reversed serpentine motion by passing around a series of pulleys. The object of this is to give the head a symmetrical form, not attainable if the belt travelled in a horizontal direction, and also to allow the composition to cool and stiffen. The splints are now discharged from the duplex band upon a cutting mechanism consisting of a pair of disc cutters rotating with their edges in contact. The shafts of each disc carry on either side a disc of rubber by which the splint is gripped and prevented from moving sideways or upward whilst being cut. The now severed matches fall into trays carried upon an endless belt, the trays when filled being removed and laid away for the heads to thoroughly harden.

—W. D. B.

Improvements in the Manufacture of Explosives and in the Treatment of Materials to be employed in the said Manufacture. E. Luck and F. B. W. Roberts. Eng. Pat. 12,292, September 11, 1884.

THIS patent covers two distinct processes, one for refining sodium or potassium nitrate, the other for the preparation of a carbonaceous substance. According to the first, a quantity of plumbic nitrate equivalent to the sodium chloride present in the nitrate is added to the dissolved nitrate, which is then refined as usual. According to the second, wood or a carbohydrate is treated with nitric acid until the whole is reduced to a pasty pulp, the acid neutralised with sodium or potassium hydrate or carbonate, the whole evaporated to dryness, and the product used in the preparation of gunpowder to replace a part of the charcoal. Or the alkaline treatment may precede the application of nitric acid.—W. D. B.

Improvements in the Manufacture of Blasting Powder from Nitrated Cellulose. An Amendment of Specification 13,522, October 13, 1884. See J. Soc. Chem. Ind. iv. 243.

THE claim for the hardening process is now struck out, the claim being now simply "a new method of manufacturing blasting powder, by sawing pieces of strongly pressed nitrated cellulose."—W. D. B.

An Improved Coating for Explosive Compounds and Cartridges. Michael Cock, Victoria. Eng. Pat. 14,561, October 30, 1884.

THE cartridges or explosive compounds which it is desired to coat are warmed and dipped into melted sulphur, either alone or in admixture with other substances—e.g., black lead or iron. The application of this invention is not confined to any particular kind of explosive, nor to the use of pure sulphur, or any particular mixture or compound of sulphur.—W. D. B.

Improvements in Apparatus for Sulphurising and Phosphorising Friction Matches. J. A. Elliot. From Edson Fitch, Quebec, Canada. Eng. Pat. 14,992, November 14, 1884.

THIS invention relates to a continuous apparatus for the manufacture of matches. The splints, in double lengths, are placed promiscuously in a hopper, one side of which can be agitated in order to shake the splints compactly together, thence received between two endless bands running parallel together for a portion of their length between guides provided with adjustable clamps, enabling the bands to hold the splints with sufficient firmness. The splints having been dried by passing over a furnace are ready for sulphurising. To effect this, the belt is canted over by appropriate guides, the splints brought into a vertical position, and their ends dipped alternately in a pan of sulphur kept melted by steam pipes. After sulphurising, the splints are permitted to return to their horizontal position, and brought over the pan containing the phosphorising compound; revolving, bevel-edged wheels transfer the heading composition to the splints, and also bring the ends of the splints in line. The heads are hardened by the application of a cold blast of air, and the splints finally cut in two by a rotary knife.—W. D. B.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

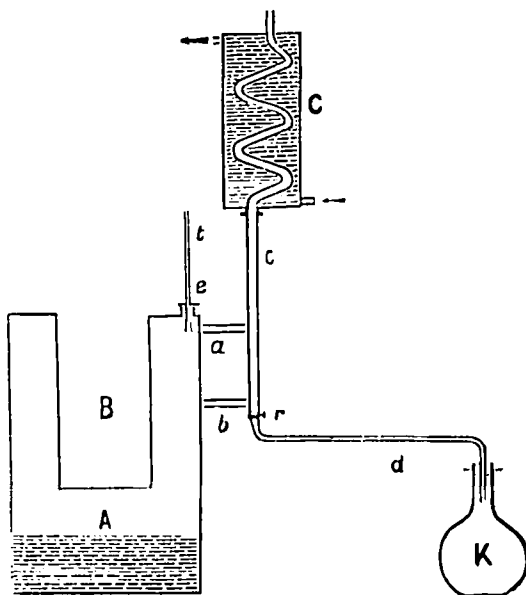
A Red Colouration of Cyanide Solutions. Louis Habel. Ber. 17, 2840.

SOME years ago, while preparing cyanogen compounds of selenium in Prof. Bunsen's laboratory, the author observed a remarkable cherry-red colouration on warming a solution. A similar colouration has been repeatedly observed by the author in the decolourisation of ammoniacal copper solutions by addition of potassium cyanide. The same colouration was noticed in the separation and distillation of hydrocyanic acid from silver cyanide. The author also remarks that in testing for cyanides in presence of sulphur compounds by the Prussian blue reaction, a decinormal acid solution should be employed.

—S. Y.

A New Thermo-regulator. A. Fock. Ber. 18, 1124.

THE principle of the regulator is based on the fact that a bath of some volatile liquid like mineral oil, provided with a back-flow condenser, when heated to its boiling



point will remain at a constant temperature. The more volatile portions of the liquid are distilled off until the required temperature is reached, when by closing the

flow-off tap the condensing worm is brought into action and the liquid is maintained at this temperature without regulating the source of heat. The arrangement as shown in the diagram will be at once apparent. The thermo-regulator is recommended for melting-point determinations, and as the bath is opaque the difficulty occasioned thereby is overcome by adapting an electric signal to indicate the moment of melting, or by providing the bath with a mirror. This apparatus may also be used as an air-bath by closing the inner chamber with a cork.—J. B. C.

Titration of Iron Ores. Walther Hempel. Ber **18**, 1130.

THE analysis of iron ores offers considerable difficulties, since the gangue always contains a considerable quantity of iron insoluble in acid which cannot be determined except by a separate fusion, and the metal is present partly as ferric and partly as ferrous oxide. To obviate this the author proposes the following simple method: The finely-powdered ore (about 3grm.) is mixed in an agate mortar with pure sodium carbonate (4grm.) and pure calcium carbonate (2grm.), and ignited in an open platinum dish; by this means the iron is completely converted into ferric oxide, which can then be estimated by dissolving the mass in hydrochloric acid and titrating with stannous chloride. All iron ores are readily decomposed by this method.—A. G. G.

A New Reagent for the Absorption of Oxygen. O. Pfordten. Annalen, **225**, 112.

FOR absorbing oxygen the hydrochloric acid solution of chromous chloride is used, made by reducing a solution of chromic acid in hydrochloric acid with zinc and hydrochloric acid, and filtering the solution in an atmosphere of carbonic acid through asbestos, or glass wool, into a solution of sodium acetate. The precipitated chromium acetate is washed and dissolved in hydrochloric acid. Carbonic acid, sulphuretted hydrogen, and other gases which do not act on chromous chloride, can thus be freed from oxygen. The blue solution, as it becomes green by oxidation, can also serve as a sensitive indicator for oxygen. A special apparatus has been devised for this purpose.—S. H.

On a New Method of Estimation of Manganese in Spiegeleisen, Ferromanganese, and the most Important Ores. Wilhelm Kalmann and Alois Smolka. Monatsch. Chem. **6**, 65.

THE author heats 0.15 to 0.3grm. of the finely-powdered substance (it should not contain more than 0.15grm. of manganese) in a platinum crucible, first with a burner, and lastly with the blowpipe, whereby the manganese is converted into manganomanganic oxide. About twenty times the weight of a mixture of two parts of fused borax, and three parts of sodium and potassium carbonates is fused and powdered, and added to the oxidised substance. The mixture is fused for fifteen or twenty minutes in the closed crucible, and afterwards for five minutes without the cover, the mass being stirred. The contents are then thrown into a measured quantity of a titrated solution of ferrous sulphate acidified with sulphuric acid. The excess of ferrous sulphate is estimated with permanganate. The manganese is calculated thus:—Weight of iron: $x = 10 \times 50 : 6 \times 55$. The author finds that, in the fused mass, for every six atoms of manganese there are 5 atoms of available oxygen. The results by this method differed very little from those obtained gravimetrically. With ferromanganese, rich in manganese, the determinations by the new method may vary 1 per cent. It is most suitable for substances in which the manganese is converted into Mn_3O_4 by simple heating, and which contain at least 1 or 2 per cent. of that metal. The result may be 2 to 3 per cent. too low if the manganese is present as silicate.—S. Y.

Estimation of Titanium in Iron and its Ores. A. Ledebur. Chem. Zeit. **9**, 483.

THE ore to be analysed (2.5grm.) is treated with concentrated HCl evaporated to dryness on the water-bath, the residue heated with a little HCl, diluted with water, filtered and washed with cold water. The residue on the filter is dried, fused with sodium potassium carbonate, the fused mass moistened with water, treated with large excess of HCl and evaporated on the water-bath. To the residue concentrated HCl is added, heated gently for a time, diluted with cold water, filtered and washed with cold water. The two filtrates are united and contain all the titanic acid. It is advisable to test the silica residue by boiling with carbonate of soda solution, in which it should dissolve completely. The titanic acid solution is treated with sufficient sulphuric acid to convert the total chlorides present into sulphates, and evaporate down until all the HCl is given off and the H_2SO_4 begins to fume. The solution is allowed to cool, diluted with water until all the crystallised salts are redissolved, sulphurous acid or $NaHSO_3$ is added, and then gently heated to reduce the iron present. The solution is then neutralised with Na_2CO_3 as far as possible, so that no permanent precipitate forms, and heated in a flask to boiling for two hours. The evaporated water is replaced from time to time, and small quantities of the bisulphite added. The titanic acid precipitates also phosphoric acid and some iron. Filter and wash with water. The precipitate is dried and fused with sodium potassium carbonate and treated with water, whereby the phosphoric acid is dissolved. The residue, consisting of titanic acid and iron, is treated with sulphuric acid, and submitted to the process of boiling and reduction by $NaHSO_3$, as before, to get rid of the iron. To determine titanium in iron 15grm. are dissolved in nitric acid, evaporated and strongly heated to destroy carbon compounds and to drive off HNO_3 . The residue is dissolved in concentrated HCl, diluted with water and filtered. The residue on the filter after washing and drying is fused with Na_2CO_3 and KNO_3 , the silica separated by evaporating with HCl, and the process continued as above.—J. B. C.

Separation of Zinc from the Group-metals. W. Hampe. Chem. Zeit. **9**, 543.

BY converting zinc, iron, nickel, cobalt, manganese, and aluminium, into formates, and passing H_2S through the solution, ZnS precipitates completely. The precipitate is always free from Mn and Al, and also from Ni, Co and Fe, if the solution contain sufficient quantity of formic acid (at least 15-20cc. acid of 1.2 sp. gr. to 250-500cc. of liquid), and these metals are not present in excess. Fe comes down most readily in such cases, and traces of Ni and Co. In order to eliminate these metals, the filtered and washed precipitate is dissolved in HNO_3 , saturated with NH_3 , then formic acid added, and the solution reprecipitated with H_2S . In order that the ZnS may be easily filtered, the precipitation is done in a hot solution. The precipitate must be washed with H_2S water, containing formate of ammonia and formic acid. The quantitative tests of the method have been confined to the analysis of zinc blends. The ore is dissolved in nitric acid, saturated with H_2S , the precipitate dissolved in HNO_3 , and reprecipitated. The two filtrates are united, saturated with ammonia, formic acid added until the precipitate redissolves, and the hot liquid precipitated with H_2S . The ZnS is then heated in a current of hydrogen, and weighed as metallic zinc.—J. B. C.

Nickel Apparatus for Laboratory use. F. Stolba. Chem. Zeit. **9**, 673.

NICKEL vessels are an excellent substitute for those made of iron or copper. When nickel basins are heated directly by the Bunsen lamp, the colourless flame should be used, as a deposition of soot produces brittleness of the metal. These basins may be used for boiling with caustic alkalis or their carbonates. Crucibles of nickel may be employed for fusing minerals or salts with caustic

or nitrates of the alkalis. Water-baths, spatulas, tongues, etc., of nickel are very serviceable. Nickel is attacked by acids even in dilute solutions, and also by acid salts. It withstands to a remarkable degree the action of strong H_2SO_4 . Cerite may be decomposed with concentrated H_2SO_4 in a nickel basin without any injurious effect. Minerals may be treated with fluor-spar and strong sulphuric acid. To what extent hydrofluoric acid affects nickel has not yet been determined. Lead or its oxide do not attack the metal. Platinum vessels, in which substances are to be decomposed by heating with NH_4Cl , may be advantageously replaced by nickel ones. Nickel triangles cannot be recommended, as they become brittle after a time. Nickel tripods and wire gauze are very useful and durable. The apparatus tested by the author was manufactured by Fleitmann, of Iserlohn.

—J. B. C.

On a Reaction of the Aldehydes. Arthur Calm. Ber. **17**, 2938.

THE author has examined the action of various amido-compounds on aldehydes, and describes fully the compound formed by the action of equal molecules of benzaldehyde and paramido-dimethylaniline. The substances are mixed either directly or after dilution with alcohol. The product formed is parabenzyldine-amido-dimethylaniline, $(\text{CH}_3)_2\text{N} - \text{C}_6\text{H}_4 - \text{N} = \text{CH} - \text{C}_6\text{H}_5$. It forms light yellow scales or needles melting at 93° . It is but slightly soluble in cold alcohol, but dissolves readily in hot, hence it is easily purified. It is decomposed by strong acids with liberation of benzaldehyde. The hydrochloride, $\text{C}_{13}\text{H}_{14}\text{N}_2 \cdot 2\text{HCl}$, was prepared by passing dry hydrochloric acid gas into an ethereal solution of the base.—S. Y.

Characteristic Reaction for Secondary Alcohols. G. Chancel. Compt. Rend. **100**, 601-605.

By the action of nitric acid on the secondary alcohols, dinitro derivatives are formed. Methylbutylcarbinol with an equal volume of nitric acid of sp. gr. 1.35 gives an oil which, when mixed with alcoholic potash, forms a crystalline potassium dinitrobutane. Dinitrobutane gives on reduction normal butyric acid. Methylhexylcarbinol on similar treatment yields dinitrohexane, which forms by reduction normal caproic acid. To detect a secondary alcohol the following method is proposed: 1cc. of the alcohol is treated with nitric acid, the solution poured into water shaken out with ether, and alcoholic potash added. If yellow prisms of the potash salt of the dinitrohydrocarbon form, a secondary alcohol is present.

—J. B. C.

New Books.

A TREATISE ON PRACTICAL CHEMISTRY AND QUALITATIVE INORGANIC ANALYSIS. Adapted for Use in the Laboratories of Colleges and Schools. By FRANK CLOWES, D.Sc., London. Professor of Chemistry at the University College, Nottingham. Fourth Edition. London: J. and A. Churchill, 11, New Burlington Street. 1885.

THIS work, now in its 4th edition, is a small 8vo volume bound in black cloth, with frontispiece representing one of the Laboratory Benches of the University College of Nottingham. This frontispiece is used also in illustration of remarks contained in a chapter on laboratory fittings (Section VII.). Next follows the preface, in which the author states it as his aim throughout to give all necessary directions so fully and simply as to reduce to a minimum the assistance required from a teacher. He also claims to employ language both simple and intelligible, by avoiding the unnecessary use of scientific terms, and by explaining and paraphrasing in ordinary words any such terms when they are introduced for the first time. The table of contents contains references both to paragraphs and pages, and the subject matter

is divided into sections instead of chapters. Interspersed in the text are fifty-five wood-cuts, and numerous useful tables. The work terminates with a copious alphabetical index. The general plan and method of the work will be gleaned from the following abstract of the contents:—Section I. The Preparation and Use of Apparatus. Section II. Experiments Illustrating the Preparation and Properties of certain Gases and Liquids. Section III. Analytical Operations, Descriptions Illustrated by Experiments. Section IV. Analytical Reactions, subdivided into *Reactions for Metals* and *Reactions for Acid-Radicals, Organic Acid Radicals*. Section V. Analysis of Simple Substances containing one Metal and one Acid-Radical. Section VI. Full Analytical Course and Tables. Reactions and Detection of the Rarer Elements. Reactions of certain Organic Substances. Section VII. Laboratory Fittings, Apparatus, Chemicals and Reagents. A useful List of Apparatus for each Bench-locker is also given on a fly-leaf facing the first page of the text.

COMMERCIAL ORGANIC ANALYSIS. A Treatise on the Properties, Proximate Analytical Examinations, and Modes of Assaying the various Organic Chemicals and Products employed in the Arts, Manufactures, Medicine, etc., with Concise Methods for the Detection and Determination of their Impurities, Adulterations, and Products of Decomposition. By ALFRED H. ALLEN, F.I.C., F.C.S., Public Analyst for the West Riding of Yorkshire, the Northern Division of Derbyshire, and the Boroughs of Sheffield, Chesterfield, Doncaster, Wakefield, etc. Second Edition, revised and enlarged. Volume I. Introduction, Alcohols, Neutral Alcoholic Derivatives, Sugars, Starch and its Isomers, Vegetable Acids, etc. London: J. and A. Churchill, New Burlington Street. 1885.

OCTAVO volume, bound in cloth, containing preface, table of contents and 476 pages of subject matter, including an introduction covering two pages, and an alphabetical index covering ten. The work is illustrated with 10 wood engravings, and 1 sheet diagram representing the various starch granules, besides numerous excellent and useful tables. The following abstract of the leading divisions in the table of contents will furnish a correct idea of the subjects treated of in the text, and to some extent of the mode of treatment:—Introduction; Preliminary Examination of Organic Bodies; Specific Gravity; Observations of Changes of Physical State; Optical Properties; Ultimate or Elementary Analysis; Behaviour of Organic Bodies with Solvents; Behaviour of Organic Bodies with Reagents; Examination for Inorganic Matters. ALCOHOLS: Definition of an Alcohol; Methyl Alcohol; Ethyl Alcohol; Alcoholic or Fermented Liquors; Amyl Alcohol. NEUTRAL ALCOHOLIC DERIVATIVES: Ether; Compound Ethers; Aldehydes; Chloral; Chloroform. SUGARS: Constitution and Classification of Sugars; Relations of the Sugars to Polarised Light; Specific Gravity of Saccharine Solutions; Action of Strong Acids on Sugars; Action of Dilute Acids on Sugars; Inversion; Fermentation of Sugars; Action of Alkalis on Sugars; Reactions of the Sugars as Reducing Agents; Recognition of the principal kinds of Sugar; Cane Sugar; Sucrose; Malt Sugar; Maltose; Milk Sugar; Lactose; Glucoses. STARCH AND ITS ISOMERS: Tabular List of Isomers of Starch; Cellulose; Starch; Dextrin; Gums; Proximate Analysis of Plants: Composition of Cereals, etc. ACID DERIVATIVES OF ALCOHOLS AND VEGETABLE ACIDS: Reactions of Vegetable Acids with Reagents; Acetic Acid; Homologues of Acetic Acid; Lactic Acid; Oxalic Acid; Succinic Acid; Malic Acid; Tartaric Acid; Citric Acid; Errata; Index.